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Makes Machine Tool Castings

Description of Plant and Equipment in Which the Molding, Melting and Cleaning Facilities Are Particularly Adapted to the Production of High Class Castings

By PAT DWYER

WIDE diversity of product and the manner in which changes, innovations, and other features are introduced from time to time in the design of machines to keep pace with industrial progress, cause a foundry devoted to the manufacture of machine tool castings more nearly to resemble a jobbing foundry than any other of the many classes of foundries engaged in what might be termed specialized production. Orders for from 10,000 to 100,000 duplicate castings are not uncommon in automotive, stove, agricultural, pipe, sanitary ware and car wheel foundries and when these orders are completed they are succeeded by others, similar, at least, to the others. With a definite goal at which to shoot, equipment and methods may be standardized and ordinary laborers may be transformed into skilled operators in a comparatively short time. Under ordinary circumstances the machine tool foundryman considers himself in luck when he receives an order covering all the castings for 50 complete machines of one type and even then he never is surprised to receive a supplementary order before the first is completed instructing him to change or substitute one or more castings for those originally specified.

Molding machines are employed to some extent, but a great many flasks are rammed by hand and, therefore, the majority of the operators are skilled molders capable of handling

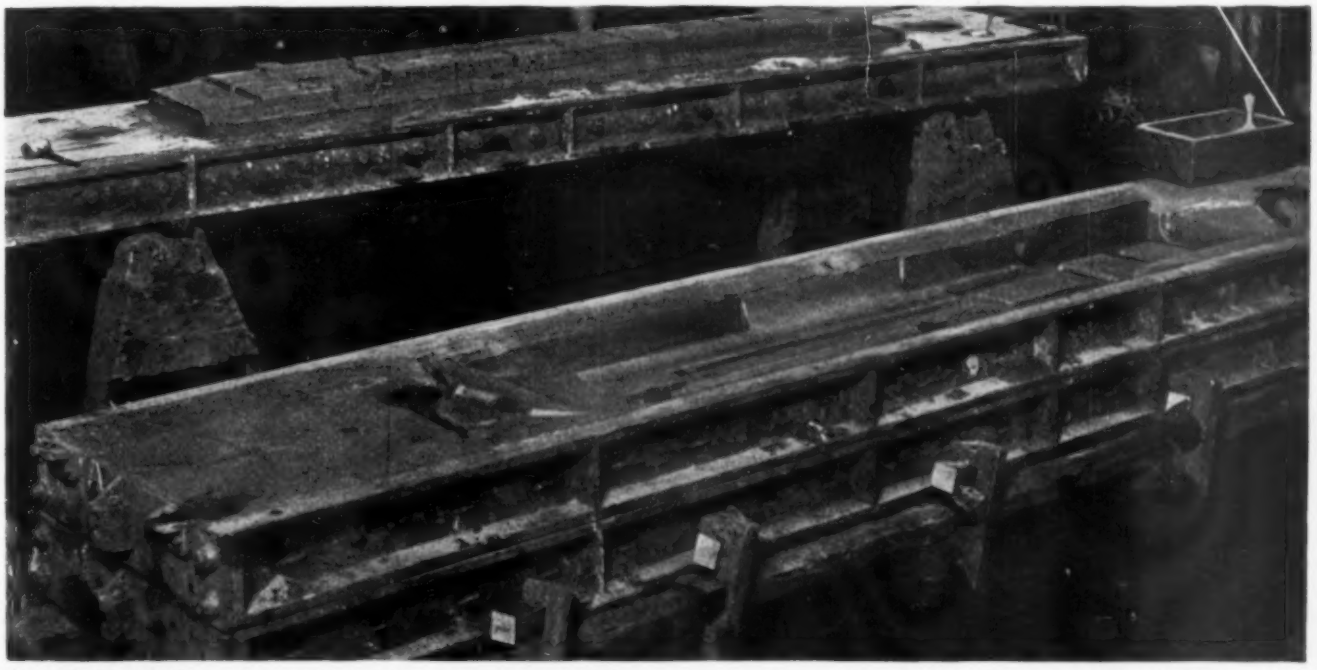

FIG. 1—A STRAINER CORE IS EMPLOYED IN ADDITION TO THE USUAL TYPE SKIMMER GATE TO INSURE A CLEAN CASTING FLASKS ARE MADE IN SECTIONS AND BOLTED TOGETHER TO FORM VARIOUS COMBINATIONS

miscellaneous work on their own initiative. The foundry operated by the Pratt & Whitney Co., Hartford, Conn., is typical in its methods of those engaged in the production of small machine tool castings.

The foundry department is a self-contained unit situated on the opposite side of the lines of the New York, New Haven & Hartford railroad from the extensive group of buildings comprising the remainder of the plant. The stock yard is served by a spur from the main line. It occupies all the space between the foundry building and the railroad track and extends about 300 feet beyond one end of the building. A 10-ton crane supplied by the Niles-Bement-Pond Co., spans the stockyard and handles all the sand, coke and iron coming into the foundry. It also is employed for breaking the scrap and for depositing the charges for the cupola on the charging platform erected on the outside of the building. It is stated that the crane with one operator and one man to hook and unhook the loads has dispensed with the services of 12 yard laborers.

The foundry building of brick and steel construction, well lighted and ventilated, is divided into three bays by the two rows of columns supporting the crane runway over the main or center bay. The cleaning room partly shown in Fig. 4, forms a continuation of the main building from which it is separated by a dividing wall. The foundry office is located in an addition built on near one end of the main building and on the opposite side from the stockyard. The ground in the vicinity of the office is utilized as a flask yard. A gallery extending all the way across one end of the building serves as a storage space for many of the smaller flasks. Access to the gallery is had by a stairway and in addition loads may be deposited and removed by the crane. The main bay of the foundry is served by one 5 and one 10-ton crane made by the Niles-Bement-Pond Co., New York.

The side bay adjacent to the office is devoted to the production of small castings. On some of the floors the molds are made on benches, on others they are made directly on the floor and on a few they are made on molding machines. Small pulleys are made on the machine shown in the illustration Fig. 2. This machine was made by a Chicago firm and is adapted to the production of pulleys from 6 to 15 inches in diameter. The illustration is self-explanatory and shows it to be a stripping plate mounted on a suitable stand and provided with a lever at each side by which the pattern may be raised or lowered. A steel pin attached to a chain to prevent it from getting lost is inserted through one of the row of holes on the side of the frame where it automatically stops the lever and regulates the distance the pattern projects above and below the stripping plate. The pattern, of course, is designed to form half the mold in the cope and the other half in the drag. A pin on one side and a pinhole on the opposite side serve to locate the half flasks in their proper relative positions on the pattern plate and afterward in relation to each other.

FIG. 2—SMALL PULLEYS ARE MADE ON A STRIPPING PLATE EQUIPPED WITH RINGS OF VARIOUS DIAMETERS THE WIDTH OF THE CASTING FACE IS DETERMINED BY A LEVER WHICH IS LOCKED BY A PIN IN A GRADUATED SERIES OF HOLES IN THE SIDE OF THE MACHINE

Practically all the flasks employed in the foundry are made of iron. Small flasks similar to those shown in Fig. 2 and others of various shapes are cast in single sections. Others similar to that shown in Fig. 1 are designed to be cast in many sections and afterward assembled to any desired size in length, width and depth. A single set of patterns serves for both cope and drag. Individual bars are bolted through elongated holes in the sides of the cope and the corresponding holes in the side of the drag serve as vent holes. Frequently the drags are requisitioned to form cheeks and in those instances chuck bars may be bolted through these same convenient holes. The sand in the pulley flasks and also in the flask shown in Fig. 1 was rammed by hand.

Combination Molding Machine

Milling machine frames similar to that shown in the foreground Fig. 5 and other patterns of the same general character are mounted and rammed on a jolt, rollover machine. This machine is a combination of two made by well known makers. The table and jolting mechanism originally was supplied by the American Molding Machine Co., Terre Haute, Ind., and afterward the rolling over device which forms one of the distinctive features of the machines made by the Hermann Pneumatic Machine Co., Pittsburgh, was added.

The side frame mold shown in Fig. 1 furnishes an interesting example of the manner in which many molds are gated to insure clean castings. The runner at each end is the familiar *storage* gate in which the iron is poured down through one opening, conducted along a passage terminating on the upper side in an opening designed to catch any dirt floating on the top of the metal stream. Small gates leading from the bottom of the opening conduct the iron into the mold. In the example shown an extra precaution has been added in the shape of a strainer core in the bottom of

the opening which feeds the small gates.

The exteriors of all the molds are formed in green sand and wherever it is considered practicable the interiors are formed in the same medium. A high degree of skill is essential on the part of the molders. The sand must be rammed to the proper degree of density at various points over the pattern to resist the varying pressure of the iron and in a manner that will produce a smooth surface on the casting and a uniform thickness of metal. A clean skin on the casting is secured by employing coal dust facing next the pattern and by applying a coating of plumbago with a camel's hair brush to the surface of the mold.

FIG. 3—INTRICATE CHARACTER OF MANY CASTINGS INVOLVES THE USE OF A LARGE NUMBER OF DRY SAND CORES MADE IN A SECTION OF THE SIDE BAYS

In a great many instances it is not economical or expedient to form the interior of a complicated mold in green sand. To meet these various requirements the extensive coreroom shown in Fig. 3 is provided. It occupies part of the side bay near the stockyard and is located directly beneath a second story floor which supports the sand storage bins. The large cores are dried in an oil fired oven made by the company itself, equipped with two 4-deck cars and also with a number of shelves attached to the walls on both sides. A second oven furnished by Young Bros., Detroit, electrically heated and thermostatically controlled and provided with drawer shelves is employed for drying the medium size cores. The small cores are dried in three swinging drawer ovens made by the Millet Core Oven Co., Springfield, Mass. All the ovens are equipped with oil burners. A light crane is provided in the coreroom for handling the cores and core plates. Hand trucks of the type shown in the right foreground Fig. 3 are employed for transporting the cores to the various points on the molding floor where they may be required. These trucks relieve the cranes of a great deal of petty lifting. Both oil sand and sand bonded with a pitch base binder are employed in making the cores. The size and shape of the core, the relative position it occupies in the mold, the area exposed to the iron, the facilities for the escape of the gas and other factors determine which form of binder is the more suitable and also the amount required to produce a satisfactory core.

A grab bucket suspended from the yard crane is employed to unload core and molding sand directly from the cars as they are shunted into the yard. In many instances this feature has proved a distinct convenience since the crane spans any point in the yard and hence there is no necessity for *spotting* the cars at any definite point. It does not matter whether a car of sand is shunted to the extreme end of an empty spur track in the yard; left in the center with loaded or empty cars at either end, or barely squeezed in through the gate on a full track; the crane can reach it and unload the sand. The same applies to other forms of raw material with the exception that a magnet replaces the grab bucket where pig iron and scrap constitute the loads.

Scrap, pig iron, coke and limestone are stacked in orderly piles at various points in the yard, but the sand is discharged from the grab bucket over a grated opening leading to a narrow tunnel equipped with a horizontal, moving belt which discharges into the boot of a bucket elevator close to the wall of the building. The bucket elevator in turn discharges the sand on to a conveyor belt which serves the various sand bins on a mezzanine floor extending the entire length of the building over the bay containing the coreroom and the cupolas. The various grades of molding and core sand are deflected to their respective bins by a traveling carriage dumping mechanically.

In addition to serving as a general storeroom for a miscellaneous supply of foundry raw material, the long mezzanine floor is utilized for a considerable space in the center as a charging floor for the two cupolas. The sand mixing equipment also is on this floor. The core sand is prepared in a revolving, paddle-type mixer made by the Blystone Mfg. Co., Cambridge Springs, Pa., and the facing sand is mixed in a centrifugal type machine made by Wm. Sellers & Co., Philadelphia. Chutes located close to each mixer conduct the sand from the second floor to suitable bins on the main foundry floor.

One 54-inch and one 72-inch cupola supplied by the Whiting Corp., Harvey, Ill., are employed for melting

the iron. Only one cupola is operated at a time and the blast pipe for the two cupolas is connected to a blower made by the Spencer Turbine Co., Hartford, Conn. A 40-horsepower motor furnishes the power for operating the blower.

During the high pressure war days when every available inch of floor space was covered with molds, when production knew no limit and when machine tools were allocated by one government board in a vain endeavor to meet the insistent demands of other government boards for unlimited quantities of war material, equipment and supplies, the larger cupola was employed constantly and the smaller cupola was held as a spare. However, since that time, with the exception of an occasional day when the heat is over a normal amount, the smaller cupola melts all the iron required in a reasonable time and the larger cupola is held ready as a spare.

In addition to the yard crane which deposits the greater part of the cupola charge on the charging floor a hydraulic elevator supplied by Craig Ridgeway & Son, Coatesville, Pa., is used for lifting coke, limestone and other miscellaneous material to the same floor. In this connection it is interesting to note that chips from a marble yard instead of limestone in the usual familiar form, are employed as a flux.

After the cupola breast is made up the tap hole is closed on the inner end with a thin film of clay and this effectually prevents the shower of sparks which usually characterizes the beginning of a heat. The metal is allowed to accumulate in the well of the cupola until the first charge is melted and then is tapped into a mixing ladle from which the regular pouring ladles are filled. The same procedure is maintained with the remaining charges and in that manner a more uniform control is exercised over the qualty of the iron. This feature will be covered more completely in the second part of this article which will appear in an early issue of THE FOUNDRY.

FIG. 4—THE CLEANING ROOM FLOORED WITH CEMENT IS LARGE, LIGHT AND AIRY AND THE SANDBLAST AND TUMBLING BARRELS ARE PIPED TO A DUST ARRESTER SYSTEM

Large castings are loaded individually on trucks and taken into the cleaning room. Smaller castings are loaded in steel pans and shifted from place to place on lift trucks. A general view of approximately one quarter of the cleaning room is shown in Fig. 4. From this it will be noted that adequate light is supplied through side windows and also through windows in the roof. The floor is smoothly surfaced with cement and, there-

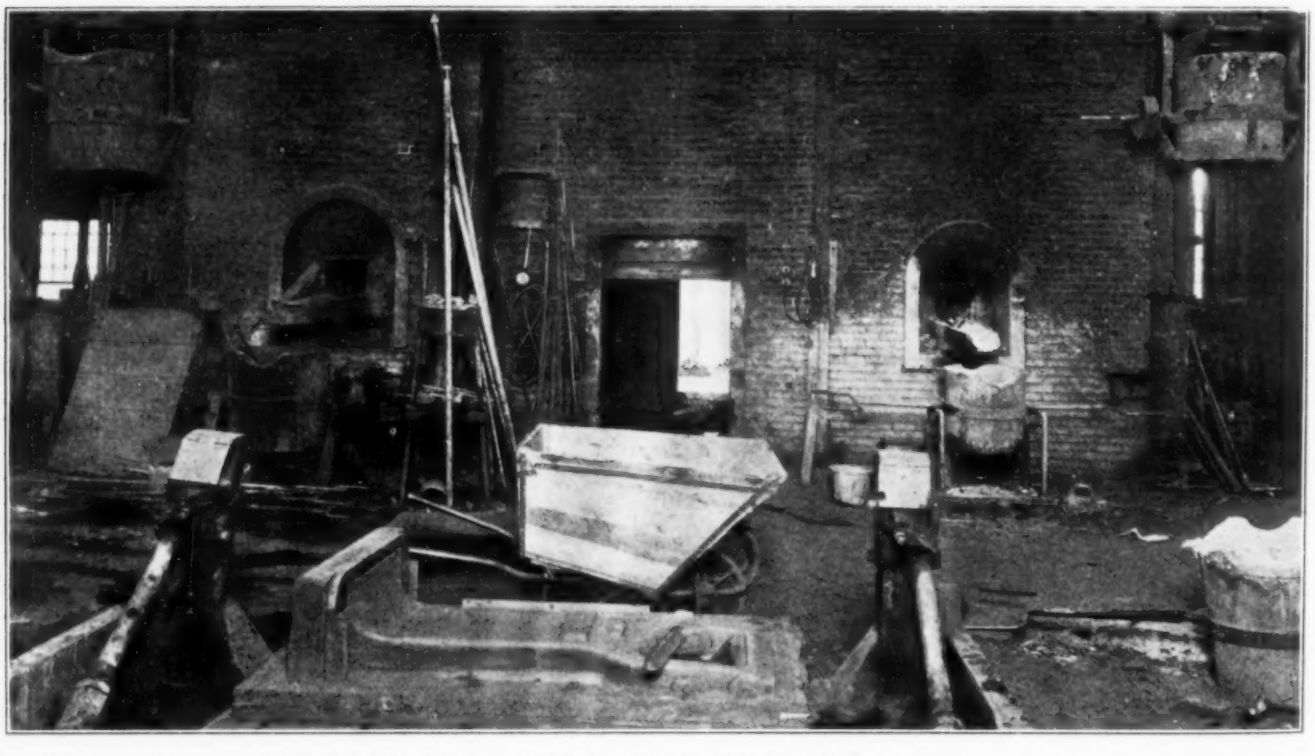

FIG. 5—THE TWO CUPOLAS ARE SERVED BY A SINGLE BLOWER WHICH MAY BE DIVERTED FROM ONE TO THE OTHER AS OCCASION DEMANDS. THE IRON IS TAPPED FIRST INTO A MIXING LADLE AND THEN POURED INTO THE LADLES EMPLOYED TO POUR THE CASTINGS

fore, easily is kept clean; besides the shifting of material from one point to another is facilitated. Two large main doors are provided in opposite walls for castings inward and outward bound. One doorway communicates with the foundry through the center of the end wall and the other doorway opens into the yard. A large elevator located inside the foundry close to the cleaning room door communicates with a tunnel leading under the stockyard and the railroad tracks. The tunnel terminates under one of the numerous machine shops in the main group of buildings comprising the plant where a second elevator is available. Thus the castings from the cleaning room may be shipped by truck from the doorway leading into the yard; or, through the tunnel.

Castings are cleaned in a rotary table sandblast machine and in a sandblast tumbling barrel made by the Pangborn Corp., Hagerstown, Md., in a sandblast barrel made by the New Haven Sandblast Co., New Haven, Conn., and in one large and two small tumbling barrels supplied by the W. W. Sly Co., Cleveland. These various pieces of equipment are located close to each other in that part of the cleaning room shown in the illustration, Fig. 4, and are suitably piped to an exhaust system which removes all the dust. Large castings are cleaned on part of the floor adjoining that shown in the illustration. Suitable equipment is provided for the purpose, including pneumatic chippers and grinders and a 5-ton crane. A pneumatic device designed originally as a pavement breaker has been adapted for removing the dry sand cores from large castings.

One section of the cleaning room has been set apart as a kind of clearing house for ingoing and outgoing patterns. Patterns on which the orders have been filled are assembled here and checked before they are taken to the pattern storage. Patterns on which the foundry proposes to start work or patterns which for any reason must take precedence are taken here a short time before they are needed in the foundry. The pattern shop in which new patterns are made and in which old patterns are repaired and altered, is located close by.

India Considers the American Coupler

IT IS understood in London that a definite decision soon will be made on the question of adopting automatic couplers on the principal railroads of India. This subject has been under discussion in India since the end of the war and over a year ago the Indian railways sent a committee to Europe and the United States to study the question. This committee, which was headed by Col. H. G. Norman White, spent several months in the United States and finally recommended the adoption of the American type of car coupling for the Indian railways.

At present the railroads in India use the European hook and link or screw type of coupling with formed side buffers. It is now proposed to substitute the American center buffer construction and American automatic couplers of a type generally conforming to the standards of the Master Car Builder's association. The standard D-type coupler will not be used because of its excessive size and weight.

The leading American manufacturers of car couplers, including the National Malleable Castings Co., Cleveland; the Buckeye Steel Castings Co., Columbus, O.; the American Steel Foundries, Chicago; the McConway & Torley Co., Pittsburgh; the Gould Coupler Co., New York; and the Monarch Steel Castings Co., Detroit, are understood to be interested in this business and to have submitted designs, some one or two of which will be adopted.

A cable received in London from India states that the chairman of the Indian railway board has recommended the adoption of the automatic coupler. If the plans which are now being considered materialize, American coupler and draft gear manufacturers will undoubtedly receive a large amount of business, since eventually many thousands of tons of castings will be required.

The contemplated change is a radical one since the American type of coupler consists chiefly of heavy steel and malleable casting, whereas the European type is made principally of forgings.

In India the advantages to be obtained from the central coupling, according to the railway administration department, include an increase in the strength of the coupling, a saving in switching time, and increased safety for the operating forces. In India in 1921-22, 29 men were killed and 129 were injured coupling cars out of a total number of railway employes of 754,478. The automatic coupling, the railway administration department report says, is becoming necessary in India on account of the heavier freight cars now in use on the standard gage lines, the average carrying capacity of the cars now being over 21 tons. There has also been a more or less general adoption in India of the 8-wheel bogie truck freight car of which the Great Indian Peninsula railroad has 1261 out of a total number of 2245 cars.

The Indian railroads are also installing air brakes on their freight trains, which is an additional reason for adopting the automatic coupler, the latter being necessary to bring about an increase in the length of trains and the use of more powerful locomotives.

It is realized that a number of years must elapse in India during which a great many couplers of both the European and American types will be in service at the same time, and for this period a transition type of coupler has been designed which can be reversed and used either as an ordinary automatic coupler or as a European type coupler.

The question of using automatic couplers is also being considered in South Africa and other parts of the British empire, most of the business being transacted through London.

New England Foundrymen Consider Sand

Use of sand in the foundry was the subject of discussion at the regular October meeting of the New England Foundrymen's association at the Exchange club, Boston, Oct. 10. William M. Saunders of Saunders & Franklin, metallurgists, Providence, R. I., introduced the subject with a description of various tests and with an account of recent work of the American Foundrymen's association in its endeavor to standardize sand tests throughout the country. R. F. Harrington, metallurgist of Hunt Spiller Mfg. Co., Boston, explained how the results of the laboratory could be translated into profits in the actual foundry. Following his remarks, George Furman, sales manager of Beardsley Pipe Co., Chicago, showed four reels of moving pictures of sand slinging machines in operation in different plants. One view showed the making of a complete bath tub mold in four minutes. From 60 to 70 members of the association were present and George A. Ray, president, held the chair.

Organizing For Safety Work

Must Be Supported Strongly by Those in Authority and Interest of Foremen Should Be Enlisted—Regular Reports Stimulate Activity—Qualifications for an Inspector Are Enumerated

BY JOHN L. THOMPSON

SAFETY work must be organized. When I use the word *organized* I mean all that the word implies. It is not enough to have a safety committee, and inspector, and other outward requisites of a safety organization. Each one of the various units and activities which constitute a real live safety organization must be coordinated before effective results are obtained. The safety department, because a department it should be, should interest the manager just as much as any other department in his plant organization and as such it would be required that proper reports be laid before some executive at regular intervals showing what progress has been made in the way of plant improvements, in the way of educating employees and finally in the way of accident reduction.

Management Responsible

The question may be asked—what more can the head of a plant do than to give his approval and see that a suitable safety inspector is appointed and that committees are formed as required by the present day organization plans? He can by word of mouth at a meeting of the foremen impress upon them the importance of saving the life and limb of every employee of the plant. He should emphasize in his discussion of the subject with the foremen that he is going to hold every one of them responsible not only for production in his particular department but also for the accidents that are caused by this production. If in his discussion he also indicates that he intends to keep in touch with the safety movement through the various channels open to him and as time goes on indicates that he has kept in touch with the things that are going on in the plant, he will do much toward keeping alive the interest that the first meeting establishes. Every foreman will then have a message to deliver to the employees under his supervision. A typewritten announcement of the intention of the concern and soliciting the cooperation of every employee in the plant might advantageously be used by being posted conspicuously on bulletin boards in the plant. Such a letter should be signed by no less a person than the president of the concern or by some one recognized at the head of the local plant organization.

Keeps Touch With Men

In the old days it was possible for the owner to know every workman by his first name. He knew something about the home affairs of John and Dick and Bill, and through his contact and his personal touch with the men, he often controlled conditions which today must of necessity be delegated to others. The man nearest approaching the old time employer who knew his employees so well is the foreman. The foreman, as a rule is a man with recognized experience in conducting the work of his department. In the average plant it is also necessary for the foreman to have another ability; namely to understand men and get along with them. The influence of the average foreman over the employees under his supervision is seldom overestimated. What better course could therefore be followed in starting a safety organization than to get the foremen together?

As a first step in this direction at this foremen's meeting, the subject well might we approached, not as a decided issue for them to follow out but rather as a matter that is up for discussion. Far better results are obtained where men are asked for an opinion as to the advisability of doing a certain thing rather than being told to do it. There is no question in my mind as to the decision of any representative body of foremen if the question is put up to them as to whether or not a safety organization should be established in a given plant. Assume, then that the matter has been so presented to the foremen of any plant. Assume again that their action has been favorable such as our experience would indicate. You can readily understand that the responsibility for the success of the organization has practically been transferred from the management to the foremen at this meeting. When I say transferred I do not mean that the management should shift the burden from their shoulders to the shoulders of the foremen, but there is a certain psychological effect in having the foreman in leaving the meeting feel that the safety organization has been established according to his wishes and that he is therefore in duty bound to support that organization and see that its objective is reached.

The next step would be the appointment of a committee of foremen to perform one of the duties as required by the safety organization plan generally recognized. This can be done either by the management, the superintendent or in my opinion a still better plan is to let the foremen themselves elect their first representatives on the committee. It should be made clear to the foremen however, that by process of rotation they will all eventually serve on this committee and some of them will perhaps be called to serve a second and perhaps a third time.

Should be Responsible

Most of us can remember that we have done things which we should not have done, yet we all know that the very thing we did has caused accidents to others. The feeling that accidents happen to other people but not to me is a considerable factor in the cause of accidents. Few of us believe unless it is instilled in us by some higher authority, that it is any of our business to look out for our neighbor as well as ourselves and help him to escape an accident.

The failure of many organizations in my estimation is due to the fact that there is too much secrecy about what is going on inside so far as safety organization is concerned. It is not a secret society. It is intended for the workman, so take him into your confidence, tell him as much as possible about safety. Keep the subject before him constantly so that his ideas as to safe practice may be incorporated in the plan of the organization, as sooner or later you will need the practical man's viewpoint of every exposure. I do not mean to infer by this that the foreman is impractical, but I wish to leave the impression that the safety inspector who has been

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Extracts from a paper presented at the meeting of the National Safety council, held in Buffalo, Oct. 1 to 5. The author is superintendent engineering and inspection division, Travelers Insurance Co., Hartford, Conn.

appointed may be competent mechanically but it is a man who lives with the job who actually knows the fine points that go forward toward making up the accident record. To get this suggestion from the workman, it is necessary that he knows what is going on, that he knows what the management is desirous of accomplishing through the safety organization of the plant.

Qualifications Necessary

It does not always follow because the man selected for the important position of safety inspector is a competent mechanic that he is the proper man to take charge of the weekly inspection work of a plant. It requires more than mere mechanical ability. He must be able to get along with his fellow employees. He must have the respect of every man in the plant. He must be sympathetic, for if he is to receive suggestions of any value, he must listen to many ideas that are new to him and which at the moment appear to be absurd. It readily can be seen that if he ridiculed these suggestions he would not only lose the respect of that individual but would forever eliminate the possibility of receiving any further suggestions from him and possibly from any of his friends.

He must be analytical, as a good safety inspector will discover a hazard before it causes an accident. He must have inventive ability to overcome problems in guarding physical exposures. He must have foresight in order to avoid accidents that can be foreseen. Also the inspector must have courage to insist on prompt institution of vitally needed regulations and appliances.

The mortality of infant safety organizations is high. While any new organized effort must be followed up whether it refers to safety or anything else it is particularly important in safety work to keep the enthusiasm that is created at the start constantly alive. One phase of safety organization work that is different from most other organization work is that once this enthusiasm has died, it is practically necessary to start the whole thing over again to make the organization a success. Therefore the management has an important duty in carrying out this fundamental. It is important that the plant be inspected every week and that the weekly report be on the desk of some official at a certain hour on a certain day. It is important that this executive sees that the safety committee meet on a given day and hour each month and that suitable records of these activities be brought to his attention at a predetermined time. A proper organization will charge the inspector with the posting of bulletins throughout the plant and see that these are changed regularly. It will charge this individual and sometimes the committee with the prompt investigation of every accident so that a record thereof may be incorporated in the minutes of the meeting and in the report that goes before the executive. The saftey inspector and the community will share jointly the responsibility of arranging for periodical talks to employees.

While it is not necessary for a plant in order to start safety organization work to have every mechanical exposure guarded, it is evidence of the earnestness and seriousness with which the management has entered the work. However it should be remembered that organized safety goes hand in hand with physical guarding of the plant. A real organization should develop recommendations for protection of mechanical exposures and in addition offer many valuable suggestions of which experience can prove the necessity.

Every One Responsible

The establishment of a safety organization gives the heads of companies an opportunity to carry out certain moral obligations to the men. It gives them a tool whereby they can see to it that care is exercised in the preventing of accidents. A manufacturer who favors production above safety and who says that accidents are inherent to his business and must be assumed by the man who works on the job is no longer an up-to-date employer. A man is a responsible being. The boy, as a youngster realizes the responsibility of protecting his sister. When the boy realizes his responsibility of kinship he then begins to realize his responsibility toward the man with whom he works. We are responsible for one another. But the tendency is for every man to do his own little bit of work, attend to his own business run his own machine or his own automobile, absolutely indifferent to the welfare and safety of others. It behooves every manufacturer then to see that the men in his employ are given every opportunity to avoid the hazards of their work which not only includes the application of recognized safeguards for the mechanical exposures but the real live active organization, the purpose of which is to reduce industrial accidents to a minimum. In this manner if every one does his share, we may anticipate results that justify the establishment of a safety department.

Addressed Foundrymen

"Present and past history of the Pittsburgh Foundrymen's association shows that its members stand in no particular need of an appreciation of the value of co-operation," said R. A. Bull at the monthly gathering of that organization at the General Forbes hotel Oct. 15, on the theme "Co-operation as a Factor in Making Better Castings Cheaper." Major Bull is research director for a group of five steel foundry interests making small castings by the electric process, and he outlined briefly what has been accomplished through their co-operative research effort after giving a short history of the formation of the different foundrymen's local organizations as well as the inauguration of the American Foundrymen's association. At one time Major Bull was identified with the Pittsburgh Foundrymen's association himself, when he was vice president of the Duquesne Steel Foundry Co., and has done some important work in the American Foundrymen's association.

He entered specifically into a full explanation of the work of the special joint committee of the American Foundrymen's association on molding sands, consisting of 48 members, and described verbally and by lantern slides the apparatus which had been developed for determining the cohesiveness, fineness and permeability of various molding sands. In addition he described the equipment for three minor tests, sampling, dye absorption, and chemical analysis. He recommended the adoption of some plan whereby the Pittsburgh group of foundrymen may profit by the installation of such equipment, calling attention to the fact that an excess of $7,000,000 is spent annually in this country upon molding sand and that if but 10 per cent of this amount can be saved through such tests, the effort and expenditure involved will be worth while. He suggested that the tests may be conducted in individual plants at a total cost for all equipment of about $400, or at some central point to which sands could be sent for tests at a nominal cost per test made.

Dean C. B. Connelley of the Carnegie Institute of Technology who was present suggested the installation of the equipment at the college. President John W. Guay of the Pittsburgh Foundrymen's association stated that a meeting of its executive committee would be called to consider the question of devoting certain of the association's funds for some such educational work.

Practical Hints for Polishers

Helpful Suggestions Touching on Properties and Preparation of Glue, Correct Temperature in Setting up and Storing Wheels Together with Method of Applying Abrasive to Wheels

BY FRANCIS D. BOWMAN

THE ideal abrasive grain for polishing is one that is held in place firmly by the glue so that it is not broken away before it has performed its full quota of work. The demand for such a grain has grown tremendously during the past few years which has led producers of both natural and artificial abrasives to pay particular attention to products for polishing purposes. Abrasive grain for polishing also should be cleaned carefully for even a low percentage of foreign material lowers its cutting efficiency. Toughness is another important essential. A tough grain stands up to the work without breaking or powdering under the abrasive action. The ideal polishing grain, therefore, should be hard, sharp and tough.

The success of a setup wheel, however, is not dependent wholly on the quality of the polishing grain as other factors also are of importance. For example, the glue should be of the highest quality. It should not be bought at random. On the other hand it should be purchased from dealers who specialize in polishing room equipment. Such a company will guarantee its purity and viscosity. Cheap glue or glue that has not been prepared properly decomposes and as bacteria forms such a glue loses its holding power.

Correct Soaking Necessary

The glue should be soaked thoroughly in clean, cold water. Experience has proven that when ground glue is used it should be soaked for at least two hours. Flake glue should be soaked over night. Glue never should be boiled as boiling lowers its viscosity and adhering qualities. The glue should be heated to 150 degrees Fahr., in a clean kettle, preferably one that is water-jacketed. Experienced polishers state that glue never should be heated for more than four hours. Therefore, it should be made up in comparatively small batches at a time. In setting up the wheels, experience teaches the operator the correct proportions of glue and water to use. In this respect the following data will prove helpful:

For severe work, where the polishing wheel is brought in contact with sharp corners and rough edges and for work where 24 to 36 grits are used, the ideal proportion is one part water to one part glue.

For less severe work, where the corners of the pieces are round and the surfaces plain and where 24 to 36 grits are used, the proportion should be 5 parts water to 4½ parts glue.

For similar work where 36 to 54 grits are used, 5 parts water to 4 parts glue is satisfactory.

For similar work where 60 to 80 grits are used, 5 parts water to 3½ parts glue can be employed.

The foregoing will serve as a general guide, but local conditions may subject the proportions to slight changes.

The proper setting up of the wheels also is important and as this has a direct bearing on production, it is recommended that special men be detailed to the job. The work should be carried on in a room designed for this purpose. The surroundings should be clean and dry and the temperature should be maintained at from 75 to 85 degrees Fahr. The circulation of air should be good, but chilling drafts must be avoided if good work is expected.

The correct storage of the abrasive grain also is important. It should be kept in a clean, dry room away from dust and dirt. Each keg or container should be covered carefully for if a small quantity of No. 36 grain, for example, should be mixed accidentally with No. 80, a wheel set-up with the latter grain would leave deep scratches.

Details of Practice

In making up the wheels both the wheels and the grain should be heated to a temperature of between 75 and 85 degrees Fahr. before the wheel is coated with glue. The glue should be applied quickly and the wheel should be rolled in the grain which can be placed in a trough provided for the purpose. After the wheel is thoroughly covered it should be rolled lightly over a hard surface to set the grain. Some operators roll in the grain under pressure with excellent results. The set-up wheels should be permitted to dry for at least 10 hours when single coatings have been applied. Where double coatings are used the wheels should dry for at least 24 hours before being used. The drying should be done in a clean, warm room heated to approximately 85 degrees Fahr.

The selection of polishing wheels is

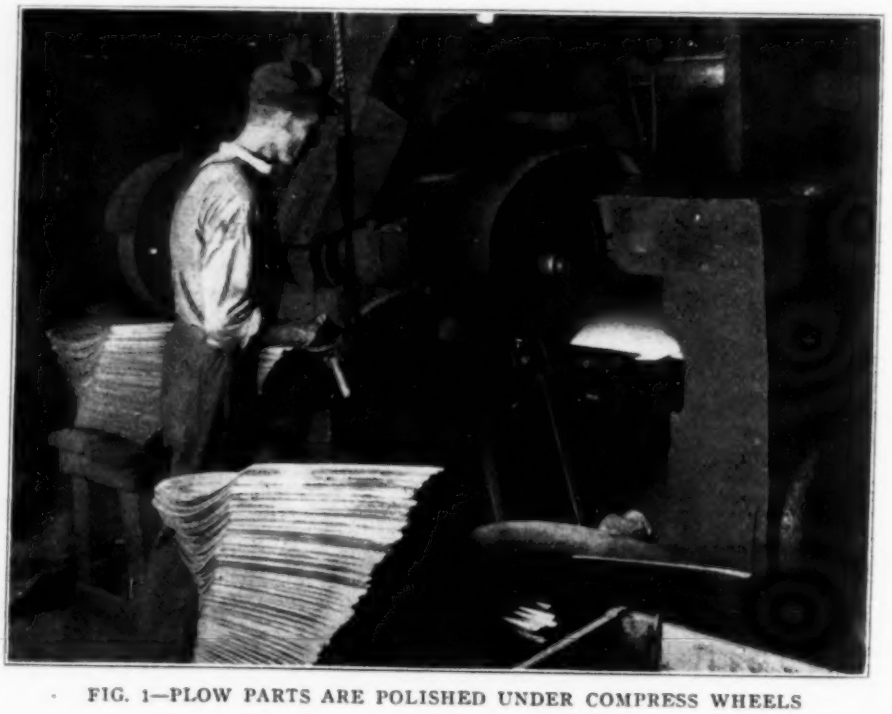


FIG. 1—PLOW PARTS ARE POLISHED UNDER COMPRESS WHEELS

The author is advertising manager of the Carborundum Co., Niagara Falls, N. Y., manufacturer of artificial abrasives and grinding wheels.

important as no one wheel can be used for a diversity with the best results. Types of polishing wheels used for various purposes vary as the accompanying illustrations show. The operation in Fig. 1 consists of polishing steel plow mold boards. This is exacting work as all the surface imperfections must be removed. As the illustration shows the work is located on a movable cradle that can be passed back and forth under the wheel. The wheel used in this instance is of the so-called compress type which is made of layers of leather located radially and held in place between two steel disks.

Careful Polishing Necessary

Fig. 2 illustrates the polishing of stove parts. The rough castings must be smoothed carefully, especially if the parts are to be nickle-plated. For rough polishing, glued canvas wheels generally are used. Compress leather wheels also can be employed with good results. Buffing after plating generally is performed on stitched muslin wheels.

The operators in Fig. 3 are polishing plumbers brass goods. A diversity of wheels can be used for this purpose. White felt polishing wheels set up with abrasive grain are used frequently for rough polishing. These wheels are resilient to a certain extent so that they conform to the shape of the work. Where harder wheels are needed, bullneck leather can be used to advantage. Such wheels can be shaped to conform to irregularities of the work and they possess the additional advantage of not breaking down rapidly on the corners. In selecting wheels and abrasives for polishing and buffing purposes it is a good plan to consult the wheel and abrasive makers' representatives. These men have had wide experience and are in position to offer valuable suggestions.

FIG. 3—PLUMBERS' SUPPLIES REQUIRE EXTENSIVE POLISHING

FIG. 2—POLISHING STOVE PARTS BEFORE NICKEL-PLATING

British Institutes To Hold Sessions

The British Institute of Metals has issued its program of arrangements for the ensuing autumn and winter. Papers will be read and addresses delivered at the London center as well as in connection with the London local section and the North east coast, Scottish, Sheffield, Birmingham and Swansea sections.

The subjects announced cover a wide range, many of interest to foundrymen. In London W. Rosenhain, in November will give some impressions of American nonferrous metallurgy, and at a joint meeting with the Institute of British Foundrymen, A. H. Mundey will give a paper on "Some Foundry Problems." At Newcastle-on-Tyne, in connection with the North east coast section, Percy Longmuir, is to speak on "General Scientific Brassfoundry Work," and S. G. Homfrey and F. Adam on "Admiralty Gun Metal." At Sheffield there is to be a joint meeting with the Institute of British Foundrymen when F. H. Hurren of Coventry will speak on "The Influence of Casting Temperature on the Physical Properties of Metals," and a second joint meeting is to take place in February.

The next annual meeting of the British Institute of Metals will be held in London, March 12 and 13, 1924, with the annual dinner on March 12. It is considered quite probable that echoes of the International foundry convention in Paris may be heard at this meeting.

Burning Oil in the Air Furnace

Successful Adaptation of This Fuel to Melting Malleable Iron Requires Proper Combustion, Close Control of Heat and Attention to the Charge

Time Element Is an Important Factor

By A. V. LANDSCHOOT

USE of fuel oil in the air furnace has to a certain extent, been looked upon with disfavor, mainly because of faulty application and lack of data to prove the merits of this fuel. The statements made here are not intended to prove the superiority of the use of fuel oil in the melting process, nor should they be taken in criticism of any other fuel in general use in the malleable castings industry today. Powdered coal, electricity and the usual hand-firing methods, all have their place and because of geographical situation, local conditions, investments involved, character of work, etc., each could easily have greater advantage over any of the other methods known to modern practice. All statements are based upon the writer's several years of melting and laboratory experience while in the employ of one malleable foundry and all data submitted is in accordance with actual conditions existing and the practice followed in the operation of this plant, regardless of the theories or methods in use in the industry as a whole.

To obtain the best results, construction of the oil-fired furnace should not only be as simple as possible but all essentials must be in harmony with each other and favor the all imporant objects; correct furnace atmosphere, proper velocity of the gases and the best possible heat absorption by the scattered charge. High air and atomizing pressures, as well as excessive draft, which necessitate radical baffling at the rear bridge wall, should in cases wherever practicable, be avoided.

The melting furnace with details shown in Figs. 1 and 2 is typical of simple construction. To give the combustion chamber the desired length a short extension was built on brackets fastened to the end plate of the orginal firebox. The bung line has a gradual slope from its highest elevation to a point midway between the front bridge wall and tapping hole. This arrangement promotes a better mixture of the secondary air with the first product of combustion; furthermore, it causes the heat to be deflected upon the charge. The roof above the hearth of the furnace is practically level and no higher than necessary to accommodate a slight excess of the usual charge. A gentle curve beginning at the back charging bung corresponds to the size of the wall opening and favors a desired deflection of the leaner flame upon the extreme portion of the charge.

The size of the bridge wall opening is largely determined by the action of the furnaces gases. Any back pressure through the skimmer door, however slight, is avoided by a corresponding increase of opening. The stack being only 50 feet high and 3 feet in diameter necessitates a large bridge wall opening; this feature, however, is desirable as it promotes a uniform speed of the moving gases over the entire charge and tends to prevent excessive heat radiation through bungs and side walls. The larger bridge wall openings, in preference to a high stack, also favors a more uniform temperature throughout the furnace, as indicated by the melting effect on the back portion of the charge. The apparent waste of heat in the neck of the furnace is curbed in an effective manner by the function of the checkwork opposite the stack outlet of the furnace.

Only one high pressure burner is used for firing purposes. This burner is of the simple, fan tail external mixing type and has been in constant use for years. The oblong fuel and atomizer openings are independent of each other and there is no possibility of clogging or carbon desposition at the orifices. The oil as it passes out perpendicularly under suitable pressure is struck forcibly at a right angle by the steam used for the atomizer and a broad, fan shaped flame, corresponding to the shape of the combustion chamber is produced. Air at fairly low pressure, is admitted through a 14-inch pipe below the burner, in quantities barely sufficient to produce the first product of combustion. Even a tendency toward carbonization against the combustion chamber roof or a noticeable backfiring toward the burner is tolerated without concern. A steam pressure of 20 to 30 pounds is sufficient to atomize the fuel and give the proper velocity to the burning mixture.

The oil is pumped from large storage tanks through a twin strainer into a small preheating tank provided with an air cushion. The pulsation effect, caused by the strokes of the pump, is thus eliminated and a constant and steady pressure at the burner insured. The oil and steam supply pipes leading to the burner are incased side by side in one insulating cover. A temperature of about 130 degrees Fahr., as indicated by the thermometer on the oil line near the burner seems sufficient to reduce the viscosity of the oil to a point where it seems to flow freely.

Furnace Repair and Fuel Data

	Total for period	Per ton
Repair, including hauling brick and material, building bungs, etc.	1,030 hours	32 minutes
Roof repairs:		
13-inch bungs	34	
13-inch bung brick	1,054	
18-inch bungs	54	
9-inch bung brick (straight and arch)	3,890	
Bung brick (9-inch equivalent)		3.0 brick
Sidewalls, including combustion chamber, hearth, neck and bridgewalls.		
9-inch straight brick	5,790	
9-inch wedge brick	250	
9-inch arch brick	370	
Soaps	330	
Splits	540	
Sidewall brick per ton		3.8 brick
Tapping blocks	44	
Bales of straw	22	
Fireclay	39,200 pounds	20.0 pounds
Silica sand	51,700 pounds	26.7 pounds
Fuel oil	119,800 gallons	61.9 gallons

From a paper presented at the Cleveland convention of the American Foundrymen's association. The author is connected with the Iowa Malleable Iron Co., Fairfield, Iowa.

The question of burner superiority is not as important as in most oil burning systems. It is a minor factor and double stage burning is the answer. The most desirable features include one burner only; simple rigid construction and freedom from clogging, regardless of design; ease of manipulation and adjustment to conform to the shape of the most suitable combustion chamber, and very important—the ability to atomize fuel of any specific gravity or grade offered on open markets.

In determining the size of the combustion chamber a number of points must be given due consideration. Its length is dependent upon the type of burner, as well as the pressure of the atomizing agent and the blast. A length of 9 to 10 feet seems to give the best results in connection with the external mixer burner now in use. The width and height are proportioned to the size of the furnace. The mouth of the present combustion chamber is 18 inches narrower than the furnace proper. This arrangement is preferred over full width as it affords ample protection to the side walls and promotes a more uniform mixture of the top blast and the monoxide gases.

The top blast is the important pivot upon which the main essentials of successful operation are balanced. This statement cannot be emphasized too strongly as fuel consumption and time oxidation and repairs are powerfully influenced by the application of the secondary air supply. Excessive oxidation of the elements proved the recognized stumbling block in the early stage of oil melting practice, yet an attempt to remove the source of evil, that is excess air forced in contract with the charge by elimination of the top air as a whole or in part lacked effect and proved a waste of fuel and time through failure of the liberated heat to yield its maximum intensity. It should be kept in mind, with oil as fuel, that the incorrect proportioning of the top and bottom blast, necessitated by intermittent hand-firing conditions no longer exists and since oil lends itself to a constant and most favorable fuel distribution the logical solution is first to eliminate excess air and then utilize the great advantage of double stage burning to the fullest extent. The usual 70-30 air ratio therefore is changed as soon as the furnace temperature permits to a 50-50 ratio and in order to minimize the effect of this radical change on oxidation the volume of air is reduced to approximately theoretical amounts. It is a matter of choice between two evils, too much or not enough air, and actual results rather than the generally accepted rule should determine the preference.

The most complex problem in connection with a balanced air ratio is the difficulty in bringing about a homogeneous mixture of the advancing combustible gases with a theoretical amount of overhead blast. It is of the utmost importance, therefore that the top blast be delivered in such a way that the best possible contact of fuel and air results The desired effect can only be brought about by admitting the overhead blast under fairly low pressure through a suitable number of large bung openings. With these openings across the entire width of the combustion chamber and not over 4 inches apart, the effect of the secondary air extending in every direction should be continuous and obviously but a small amount of the gases can escape final combustion. The exact location of the blow bung, the correct angle and size of the blast pipes as well as the proper air pressure, are imporant features and must be determined by repeated experiments. If the air pressure is too weak the blast will not penetrate the gases sufficiently to surround every particle of unconsumed fuel and a low temperature results where intense heat is actually needed.

In determining the pressure some consideration must be given to the secondary function of the top blast, which in addition to supplying the necessary oxygen, serves as a deflector of the burning gases upon the charge. This impingement is considered a necessary detail of successful operation in that it favors rapid and efficient heat transfer to the metal throughout the melting process and tends to break up the continuity of the heat flow to the extent that better radiation from the brickwork beyond follows. With too high pressure, however, there is danger of blowing holes through the fire and consequently increased portions of unconsumed oxygen forced in contact with the melting charge favor undue oxidation of the elements. Fortunately a certain amount of oxidation is desirable and with a properly designed top blast arrangement and its dual function in mind the elimination of the desirable portion of the elements becomes a simple, predetermined matter. A slight turn of the oil valve or a mere change of the lever controlling the overhead blast openings does the trick.

Among the outstanding advantages of oil firing are the uniformity of operation and the ability to produce the de-

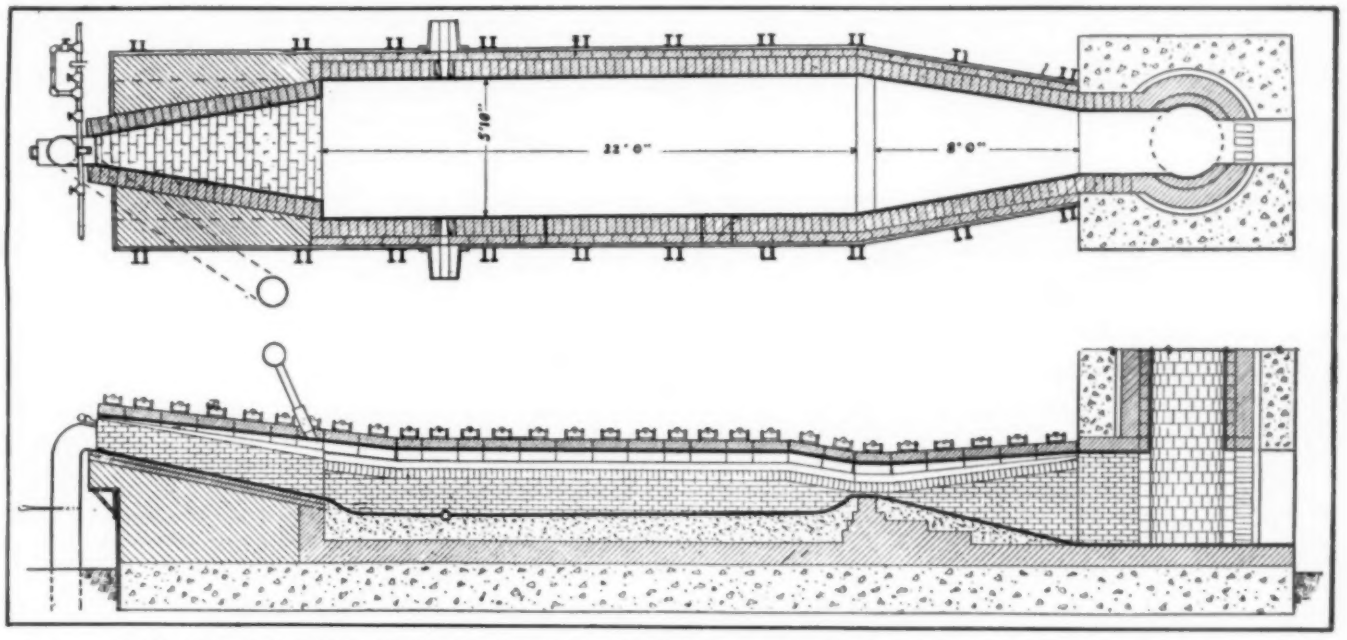


FIG. 1—PLAN AND SECTIONAL VIEW OF A 13-TON OIL-FIRED AIR FURNACE FOR PRODUCING MALLEABLE IRON

sired composition as soon as the iron has attained the proper pouring temperature. The accompanying table shows the record of twenty consecutive heats run without changing in initial charge or the method of firing in any way. This data illustrates the possibilities of oil firing as well as the uniformity of the product. The oil consumption is somewhat high, due to small heats, nevertheless these figures offer a saving for this locality of at least 20 per cent over the fuel cost of hand firing. The best oil and melting rates, as well as the most uniform results, are obtained from heats approaching the normal capacity of the furnace. If the furnace is taxed beyond capacity the oil consumption raises again a condition resulting from the abnormal increase of time required to superheat the charge, as well as the necessity to maintain a high roof over the hearth in order to accommodate the bulky charge. A rather long, narrow hearth is desirable for quick results. This construction favors heat absorption by the charge and if the top blast is properly reduced during pouring time, the molten metal need not be endangered from excess oxidation as the result of a shallow bath. Providing the initial charge, however small, is properly distributed, prompt melting and skimming, quick superheating and a corresponding decrease of pouring time will readily offset the higher oxidation rate afforded by a shallow bath.

The question of one large or two small heats per day received every consideration and has resulted in favor of two small heats, especially from the standpoint of molders' daily production. Actual trials indicate that large heats offer no economy as far as fuel consumption and other melting cost, including furnace operating and repair labor and refractory materials are concerned. Increased production and decreased foundry space reduce fixed charges and over head expense beyond any possible increase of indirect foundry labor costs.

In operating on a two-heat schedule, the 9-hour day is divided by the noon hour into two separate and complete periods of 4½ hours each. Of each period nearly 4 hours are devoted to molding; the remaining half hour to pouring, dumping and the removal of castings from the sand. Owing to efficient furnace control this schedule now is followed with almost clockwork precision. All overtime is eliminated, with the exception of sand cutting, and the necessary furnace repairs at each week end.

In considering the behavior of the elements during melting, little attention need be paid to the sulphur content of the charge. The increase is invariably small and seldom in excess of 10 per cent of the original content. Unless off-sulphur pig iron is used intentionally the hard iron always analyzes below 0.05 per cent sulphur.

Pig Iron Selection

Phosphorus is controlled easily; its gain is in proportion to the melting loss and a fairly constant figure is readily obtained through suitable pig iron selection. As a safeguard against annealing troubles, this element is seldom allowed to run above 0.18 per cent. The extra margin of fluidity that a higher phosphorus content might impart to the molten metal is too insignificant to jeopardize the product to an extent that cannot be predetermined.

The oxidation of silicon and manganese goes hand in hand and takes place mostly while the charge is melting. The nature and amount of slag indicates whether the elimination of these elements has been moderate or excessive. With comparatively low losses corresponding to the figures submitted in the accompanying table the slag proves viscous and amounts to about 135 pounds per ton of metal charged. With higher silicon and manganese losses the slag appears more fluid and increases in weight at the approximate rate of 10 pounds per ton for every 10 points additional silicon loss. This condition, however, is somewhat influenced by the carbon loss, which has an indirect, yet noticeable effect upon the erosion of the sidewalls below the metal line and consequently upon the basicity and bulk of the slag. The extent of the silicon and manganese loss depends mainly upon the excess of total or top air, the position of the wind bung, efficient distribution of the charge and its initial content. Excessive oxidation of these elements, as a direct result of the bessemerizing effect of too high top air pressure, is not desirable, in spite of the attractive oil rates obtained.

The amount of silicon and manganese eliminated in this practice depends upon the composition of the pig iron in the stock, as well as the supply of available sprue. The total remelt seldom runs in excess of 40 per cent of the charge in spite of the light to medium class of

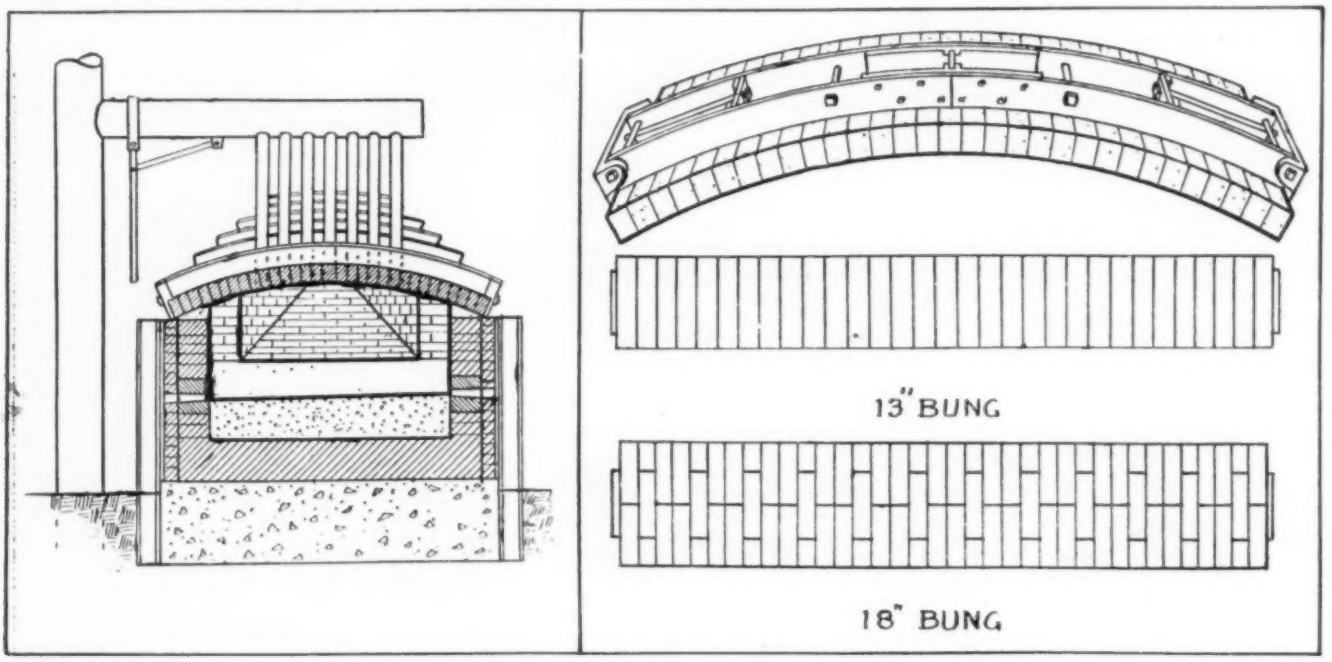


FIG. 2 (LEFT)—CROSS SECTIONAL VIEW OF A 13-TON OIL-FIRED MALLEABLE FURNACE. FIG. 3 (RIGHT)—SKETCH SHOWING CONSTRUCTION OF FURNACE BUNGS, FRAMES AND SETTING OF BRICK FOR 13-INCH AND 18-INCH BUNGS

Record of Twenty Consecutive Heats Run from Oil-Fired Furnace

Tests Made Without Changing or Adjusting Charge and Method of Firing. Contents of Charge, 50 Per Cent Pig Iron, 40 Per Cent Sprue, and 10 Per Cent Malleable Scrap

									Analysis of Charge					Analysis of Hard Iron					Loss and Gain of the Elements				
Date	Heat No.	Weight of charge Lbs.	Gals. oil used	Gals. per ton	Fire started	Heat Tapped	Time Per Heat Hrs.	Min.	Sil. Per cent	Sul. Per cent	Phos. Per cent	Man. Per cent	Total Carbon per cent	Sil. Per cent	Sul. Per cent	Phos. Per cent	Man. Per cent	Total Carbon per cent	Sil. loss	Sul. gain	Phos. gain	Man. loss	Tot. Carbon Per cent
11/14 A.M.	290	17000	530	62.5	8:20	11:20	3	0	1.27	.042	.160	.38	3.01	.92	.044	.164	.28	2.51	.35	.002	.004	.10	.50
11/14 P.M.	292	17000	530	62.3	2:20	5:05	2	45	1.29	.042	.159	.37	2.98	.92	.043	.166	.27	2.38	.37	.001	.005	.10	.60
11/15 A.M.	294	17000	540	63.5	8:20	11:20	3	0	1.28	.041	.163	.38	3.02	.96	.046	.163	.26	2.54	.32	.005	.000	.12	.48
11/15 P.M.	296	17000	500	58.8	2:15	5:00	2	45	1.28	.041	.164	.37	2.97	.91	.047	.167	.27	2.58	.37	.006	.003	.10	.39
11/16 A.M.	298	17500	560	64.0	8:15	11:20	3	5	1.30	.042	.162	.37	3.04	.95	.045	.165	.26	2.49	.35	.003	.003	.11	.55
11/16 P.M.	300	16500	530	64.2	2:10	5:00	2	50	1.28	.043	.164	.37	3.06	.94	.047	.173	.24	2.46	.34	.004	.009	.13	.60
11/17 A.M.	302	17000	560	65.9	8:20	11:25	3	5	1.30	.042	.164	.37	3.02	.96	.046	.171	.26	2.48	.34	.004	.009	.11	.54
11/17 P.M.	304	17000	510	60.0	2:15	5:00	2	45	1.29	.043	.167	.36	3.00	.94	.044	.174	.25	2.41	.35	.001	.007	.11	.59
11/18 A.M.	306	15500	520	67.1	8:15	11:20	3	5	1.30	.042	.166	.37	3.01	.88	.043	.168	.24	2.34	.42	.001	.002	.13	.67
11/20 A.M.	308	17500	580	66.3	8:20	11:20	3	0	1.29	.041	.164	.36	2.99	.106	.045	.169	.27	2.11	.23	.004	.001	.09	.85
11/20 P.M.	310	17000	540	63.5	2:20	5:05	2	45	1.25	.041	.164	.36	2.96	.98	.047	.159	.25	2.37	.27	.006	.005	.11	.59
11/21 A.M.	312	17000	560	65.9	8:20	11:20	3	0	1.32	.042	.165	.37	2.88	.101	.047	.169	.26	2.46	.31	.005	.004	.11	.42
11/21 P.M.	314	17000	530	62.3	2:20	5:00	2	40	1.30	.042	.161	.36	2.97	.99	.047	.170	.25	2.41	.31	.004	.009	.11	.56
11/22 A.M.	316	17000	560	64.0	8:25	11:25	3	0	1.31	.043	.165	.37	3.00	.101	.043	.171	.27	2.42	.30	.000	.006	.10	.58
11/22 P.M.	318	15000	500	66.6	2:25	5:00	2	35	1.30	.043	.166	.36	2.99	.102	.049	.167	.26	2.58	.28	.006	.001	.10	.41
11/23 A.M.	320	16500	540	65.5	8:20	11:25	3	5	1.31	.041	.166	.37	2.99	.98	.046	.164	.26	2.44	.33	.005	.002	.11	.55
11/23 P.M.	322	16000	480	60.0	2:20	5:00	2	40	1.31	.044	.164	.37	3.05	.98	.044	.167	.25	2.50	.33	.000	.003	.12	.55
11/24 A.M.	324	17000	550	64.7	8:20	11:20	3	0	1.30	.042	.163	.37	3.00	.98	.045	.164	.26	2.39	.32	.003	.001	.11	.61
11/24 P.M.	326	16500	490	59.3	2:20	5:00	2	40	1.30	.042	.164	.36	3.02	.97	.048	.162	.26	2.56	.33	.006	.002	.10	.46
11/25 A.M.	328	17000	530	62.3	8:20	11:20	3	0	1.30	.043	.163	.37	2.98	.95	.049	.165	.26	2.53	.35	.006	.002	.11	.45
Average	.....	16750	532	63.5	A.M. P.M.		3	2 3	1.29	.042	.164	.37	3.00	.96	.046	.167	.26	2.45	.33	.004	.003	.11	.55

Pouring Time—Morning heats 11:25 to 11:55 A.M.
Afternoon heats 5:00 to 5:30 P.M.

work. No attempt has been made to establish oxidation rates below the figures given in the accompanying table as this would lead to abnormal sulphur-manganese ratios unless the usual sprue shortage is offset by high sulphur-low silicon and manganese pig iron or large amount of malleable scrap.

Carbon the Unruly Element

Carbon is the most unruly element to contend with and has proven the main source of grief during the experimental stage of oil firing. Malleable scrap or steel of uniform composition is used to reduce the initial carbon content of the charge. When no reliable scrap or no low-manganese or high-sulphur pig iron is available, the preference goes to steel in conjunction with an intentionally high oxidation rate. The idea is to normalize the sulphur-manganese ratio through elimination of the excess manganese ratio through elimination of the excess manganese. The higher metal cost thus cr ated is partially or wholly offset by a better fuel rate, incidentally followed by faster melting.

The elimination of silicon is not necessarily associated with a proportionate carbon loss. Under certain conditions either element may yield readily while the other holds tenaciously. During the first heat following the complete renewal of the furnace bottom, for instance, the carbon usually lowers abnormally, whereas the silicon and manganese persist. This tendency accounts for the higher silicon-lower carbon content of heat number 308 shown in the table. On the other hand, heats charged with the usual silicon and carbon percentages have been known to lose as high as 80 points silicon and only 35 points carbon. Similar cases, encountered during experiments, indicate that, if the silicon content is initally low to the extent that an under-balanced carbon-silicon ratio must follow, the latter element proves weaker than usual and yields abnormally, thereby favoring the carbon. The extent of the carbon loss usually is indicated by the granular to flaky structure of the final test plug, also by the color and behavior of the molten metal, the appearance of the slag and other symptoms.

The most prolific source of carbon troubles is too high top air pressure. Other troubles are complex due to the influences of numerous factors. Undue carbon elimination may result from excess air, as well as prolonged firing, brought about by poor furnace control or a desire to run abnormally large heats, requiring prolonged exposure while superheating the molten metal previous to pouring. The following data gives a fair idea as to the protection afforded by a reduced atmosphere maintained over the bath during pouring; the volume of air admitted at this time, even though far below theoretical requirements, being sufficient to maintain a uniform metal temperature.

Heat No.	First Metal Poured Silicon per cent	First Metal Poured Carbon per cent	Last Metal Poured Silicon per cent	Last Metal Poured Carbon per cent
372	0.96	2.39	0.96	2.36
374	0.93	2.48	0.91	2.45
376	0.91	2.39	0.93	2.32
378	0.92	2.56	0.88	2.47
380	0.86	2.52	0.87	2.46
382	0.95	2.49	0.97	2.46
384	0.96	2.46	0.94	2.42
386	0.99	2.60	0.98	2.45

In case of heat No. 386 the top blast was not reduced until the heat was half tapped.

Results Are Predetermined

In connection with oxidation it can be stated that the desired hard iron analysis usually is attained through predetermined elimination of the excess impurities and that the physical properties are not affected noticeably by the extent of oxidation, as illustrated by the following results:

Sample marked	Ultimate strength, pounds per square inch	Elongation in 2 inches per cent
11- 1-252-2	57,520	25.50
11- 2-257-1	56,550	28.00
11- 3-261-1	55,860	27.00
11- 4-264-2	56,140	27.00
11- 6-268-2	56,610	22.00
11- 7-271-1	56,900	18.00
11- 8-277-1	54,910	22.50
11- 9-281-1	54,220	23.00
11-10-284-2	54,470	17.00
11-13-288-2	54,505	19.50
11-14-292-2	54,990	22.50
11-15-297-1	53,690	27.50
11-16-300-2	56,242	22.50
11-17-304-2	55,740	23.50
11-18-307-1	53,822	21.50
11-20-310-2	56,240	23.50
11-21-313-1	55,780	27.00
11-22-316-2	54,550	21.50
11-23-321-1	57,010	27.00
11-24-325-1	55,150	27.00
11-25-329-1	52,030	16.50
11-27-330-2	55,810	26.50
11-28-335-1	53,850	21.50
11-29-340-2	55,330	25.00
Total average	55,330	23.40

Average of No. 2 furnace bars (samples marked 2).
Ultimate strength, 55,679 pounds. Elongation in 2 inches, 22.92 per cent.
Average of No. 1 furnace bars (samples marked 1).
Ultimate strength, 54,981 pounds. Elongation in 2 inches, 23.87 per cent.

This monthly report gives the tensile properties of an equal number of daily tests obtained from two oil-fired furnaces operated in a different manner.

The chemical data on some of these tests is shown in the accompanying table under corresponding dates and numbers. The final composition runs uniform for both furnaces, although the silicon loss averaged 56 points for the bars obtained from No. 1 furnace, as against 33 points in the case of No. 2 furnace. No. 1 furnace was charged with 54 per cent pig iron, 6 per cent steel and 40 per cent sprue; while No. 2 contained 50 per cent pig iron, 10 per cent malleable scrap and 40 per cent sprue. The favorable comparison of the average results proves that, irrespective of the initial charge, the manner of operation can be adjusted to bring about ultimate uniformity.

Repair Expenses

One of the important factors worthy of consideration in studying the operation of the air furnace is the serviceability of firebrick used for sidewall replacement and bung construction. The saving of refractory material is a recognized feature in favor of oil firing and its importance can be further emphasized by giving due consideration to the correspondingly substantial decrease of repair labor. Actual results covering a five months' run are shown in an accompanying table. The tests covered 228 heats, averaging 8.5 tons, the total melt being 1938 tons.

The combustion chamber, including the bungs covering same, seldom requires attention during repair time, in fact the life of this part of the furnace, with the exception of the extreme ends of the combustion chamber and the bottom directly below the blow bung, exceeds one year of continued service. While the furnace is repaired weekly, the 9-inch inner lining of the angle walls, or that portion of the sidewalls extending from the end of the combustion chamber toward the middle of the hearth for a length of about 10 feet, serves a three weeks' run of two daily heats. The remaining stretch of the sidewalls up to the rear bridge wall is batted wherever needed, during repair time; the bats recovered from the angle walls and the crushed salvage of the bungs are used for this purpose. By resorting to this manner of maintenance the original lining of this portion of the sidewalls serves a 7 to 10 weeks' run.

The bottom of the furnace is taken up once a week and renewed with fresh additions of washed silica sand. The brick bottom has been tried out during the course of experiments but its adoption was abandoned for various reasons. While the saving of labor and material is unquestionably in favor of the brick bottom, especially where large heats are the rule, it was found that these bottoms became ragged within a short time and the formation of pools of molten metal proved a source of additional fuel requirements.

The life of the bungs is perhaps the most interesting feature in connection with the function of refractory materials. Figs. 4 and 5 give the graphic and tabulated results as obtained from experiments with over 200 bungs on which individual records were kept. These service test, covering a 2-year period were carried on under various furnace conditions and the brick used for the purpose included different brands obtained from five firebrick producers. While it is not intended to enter into a lengthy description of results, it might prove of interest to bring out a number of definite conclusions drawn therefrom.

A saving of not less than 15 per cent of the initial cost of the brick is brought about by substituting the undisturbed 13-inch bungs with 18-inch bungs. Taking for granted that the 18-inch bungs last fully as long as the 13-inch bungs and knowing that 43 thirteen-inch bung brick have an area equal to the 72 nine-inch straight and arch brick required to build one 18-inch bung, a simple multiplication of the number of brick used by their respective price will prove this statement.

In selecting brick for bung purposes the density and porosity, as well as the texture is carefully examined as the size of the particles and the degree of burn are observed closely and given primary consideration. A comparison of numerous fractures with available data on individual service tests points to an apparent relation between actual service, porosity and spalling action. This rule, however, is not always consistent and it is found, especially in case of the denser, finer grained brick, that lack of initial spalling resistance is not a sure indication of decreased serviceability. Extremely porous brick are not desired, as a rule they spall readily, lack strength and afford poor resistance to the abuse of frequent handling.

Selecting Brick for Bungs

Mechanical strength, brought about by increased density and hardness, is the essential sought in the 13-inch brick used for the bungs on each side of the charging openings. These bungs are severely abused through contact with the de-

2 SMALL HEATS PER DAY · AVE. 8.5 TONS · 76 BUNGS USED · AVE LIFE 49 HEATS · AVE LIFE 416 TONS					2 MEDIUM HEATS PER DAY · AVE. 10.8 TONS · 74 BUNGS USED · AVE LIFE 41 HEATS · AVE LIFE 444 TONS					ONE LARGE HEAT PER DAY · AVE. 13.7 TONS · 80 BUNGS USED · AVE LIFE 31 HEATS · AVE LIFE 428 TONS				
LOCATION	SIZE	TOTAL BUNGS USED	AVE LIFE OF BUNG IN HEATS	AVE LIFE OF BUNG IN TONS	LOCATION	SIZE	TOTAL BUNGS USED	AVE LIFE OF BUNG IN HEATS	AVE LIFE OF BUNG IN TONS	LOCATION	SIZE	TOTAL BUNGS USED	AVE LIFE OF BUNG IN HEATS	AVE LIFE OF BUNG IN TONS
A	13"	2	75	622	A	13"	3	50	570	A	13"	3	44	570
B	18"	4	55	488	B	18"	4	47	493	B	18"	5	36	495
C	18"	5	49	441	C	18"	4	41	444	C	18"	5	33	445
D	13"	8	32	280	D	13"	7	26	273	D	13"	7	21	291
E	18"	5	42	363	E	18"	4	32	346	E	18"	7	25	341
F	13"	8	35	303	F	13"	7	29	307	F	13"	8	20	272
G	18"	5	46	384	G	13"	3	43	434	G	18"	5	29	400
					G	18"	4	44	479					
H	18"	5	47	406	H	13"	4	44	466	H	18"	4	40	565
I	18"	3	65	534	I	18"	4	53	573	I	18"	4	36	514
J	18"	3	63	534	J	13"	4	42	446	J	18"	4	40	534
K	18"	4	57	466	K	13"	5	36	379	K	18"	5	35	456
L	13"	6	39	330	L	13"	6	33	356	L	13"	7	21	288
M	18"	5	54	462	M	18"	4	40	421	M	18"	4	36	490
N	13"	5	46	390	N	13"	5	35	375	N	13"	4	24	343
O	18"	4	56	461	O	18"	3	57	607	O	18"	4	41	549
P	18"	3	69	601	P	18"	2	74	871	P	18"	3	46	667
Q	13"	1	131	1043	Q	13"	1	115	1219	Q	13"	1	116	1626

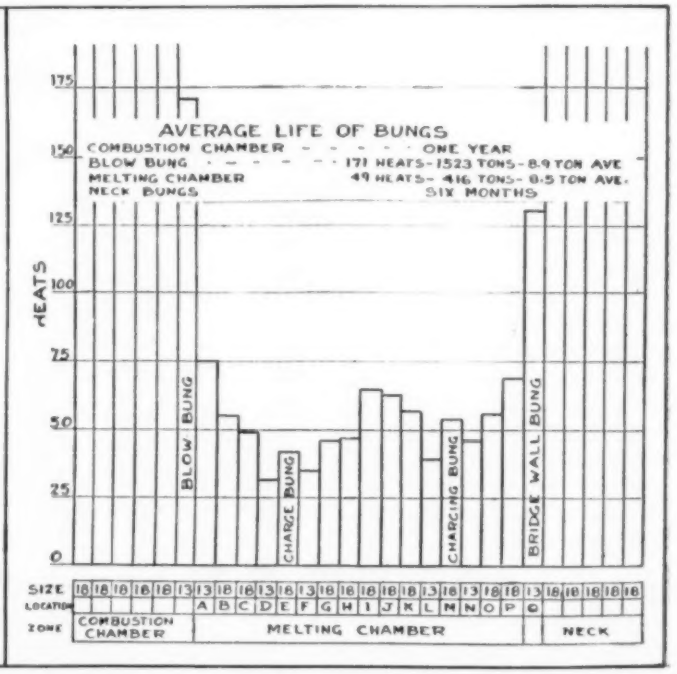

AVERAGE LIFE OF BUNGS
COMBUSTION CHAMBER · · · · · ONE YEAR
BLOW BUNG · · · · · 171 HEATS - 1523 TONS - 8.9 TON AVE
MELTING CHAMBER 49 HEATS - 416 TONS - 8.5 TON AVE.
NECK BUNGS SIX MONTHS
HEATS
175
150
125
100
75
50
25
0
BLOW BUNG
CHARGE BUNG
CHARGING BUNG
BRIDGE WALL BUNG
SIZE 18 18 18 18 18 13 13 18 18 13 13 18 18 18 18 18 13 18 13 18 18 18 18 18 13
LOCATION A B C D E F G H I J K L M N O P Q
ZONE COMBUSTION CHAMBER MELTING CHAMBER NECK

FIG. 4 (LEFT)—DIAGRAM WHICH SHOWS THE LIFE OF FURNACE BUNGS. FIG. 5 (RIGHT)—CHART INDICATING LIFE OF BUNGS ON 13-TON OIL-FIRED AIR FURNACE

scending charge and the leveling rods and in their case mechanical strength overshadows the significance of other qualities. As for the 18-inch bungs, if the texture indicates that extreme density and excessive porosity have been avoided by blending various portions of small to medium grained calcined and flint material with just enough bond clay of sufficient coarseness to give uniform cohesion and providing the initial clays possess a suitable degree of refractoriness one is almost assured of excellent service. Such brick, in spite of apparent tendency toward density, are quite neutral to expansion and contraction; the resistance to spalling, notwithstanding the general opinion to the contrary, is much greater than in the coarse, open and porous brick.

The chemical composition of firebrick for bung purposes needs no comment; this feature, as well as the expansion and contraction, seems well taken care of by the firebrick producer. This statement is corroborated in Fig. 4, showing the life of numerous bungs. A comparison of the tonnage served in the small, medium and large heats fails to indicate that more frequent cooling has a marked effect on the service of the bungs.

Improved Bung

A lower priced brick is suitable for sidewall replacements. The main requirements are of sufficient hardness and density to withstand the cutting action of the moving gases and the erosion of the metal in a uniform manner.

The bung frame used for both 13 and 18-inch bungs is shown in Fig. 3. These frames, made of malleable iron, are easily assembled and last indefinitely; they are strong and efficient and offer several advantages over the commonly used T and I bung frames. Undoubtedly the most important feature of the frame is that it leaves fully 85 per cent of the top surface of the brick work uncovered. This feature enables more uniform heat radiation through the brick work, thus insuring increased service of the bung. Another desirable point is that the bungs are readily stocked in tiers during repair time, without resultant damage to the brickwork.

In connection with the operation of the oil-fired furnace it can be stated that the importance of a great factor, human nature, often is disregarded. This condition exists in spite of abundant proof that the human factor has a tendency to curb the possibilities of an ideal fuel to the extent that uniformity and other essentials unnecessarily suffer. Costly experience, resulting from overconfidence, lack of knowledge or subsequent neglect, has proven in many instances that the principles of metallurgy, chemistry and combustion cannot be minimized in initial installation, nor disregarded in subsequent furnace adjustments necessitated from time to time by radical changes in the size of the heats or the contents of the charge.

Usually the furnace attendant is infused with a number of traditional ideas, inherited from hand-firing practice, and while these ideas obviously are detrimental when applied to a constant fuel, it is nevertheless no small task to convince the furnace man of the obsoleteness of his doctrine. Thus, the most prolific source of fuel waste and lack of uniformity is brought about by the general tendency to produce a flame that puffs through the bungs and cracks, and when in spite of discomfortable surroundings, as a result of excessive radiation and the side pressure through skimming doors, the furnace tender remains skeptical, until the metallurgist has demonstrated that a lean flame actually does the work and does it fast. Again the initiate may become so enthusiastically convinced that his previous assumption involved a waste of fuel and time and more important to him a waste of physical energy, that he resorts to the other extremity by cutting the fuel supply to the extent that excess oxidation and unruly furnace conditions must follow.

In determining the proper density of the furnace flame, a faint outline of the opposite sidewall as viewed through the back skimming door or similarly a fixed impression of the appearance of the bung above the bridgewall as seen through the stack opening serves as a guide. However, since density does not denote effectiveness unless the flame has a suitable velocity, the all-important problem—maximum heat absorption by the charge—must be solved through consideration of the interdependent conditions that impart to the flame the velocity that yields the best obtainable thermal efficiency. The wide range of straight line to circular flow of the flame, important as it is, means little to the furnace man. Again, therefore, the human element may interfere during repair time, by making a thoughtless furnace change, apparently of minor importance, thereby changing velocity and thermal efficiency.

Lack of Uniformity Explained

It is a common belief that no two air furnaces of identical proportions can be made to operate alike, but in line with the foregoing and in view of the fact that most of the usual attention is centered on heat generation and comparatively little on heat absorption, is it after all a mystery? Does it not point to the complexity of delicate conditions existing within a crude melting apparatus?

In connection with the foregoing it can be stated that the use of fuel oil offers a logical solution for further improvement along the lines of uniformity and fuel consumption. It is believed that a simple and practical operation schedule, with an additional repair schedule, in preference to haphazard firing and furnace maintenance would promote uniformity to a constant factor. These two schedules, together with the necessary modifications, covering a wide range of oxidation and small to large heats, will be based upon the results of extensive and varied experiments with large and small heats. The idea is to curb unsound practice by using a constant fuel rate with a definite air volume, in connection with a predetermined melting period for any given heat.

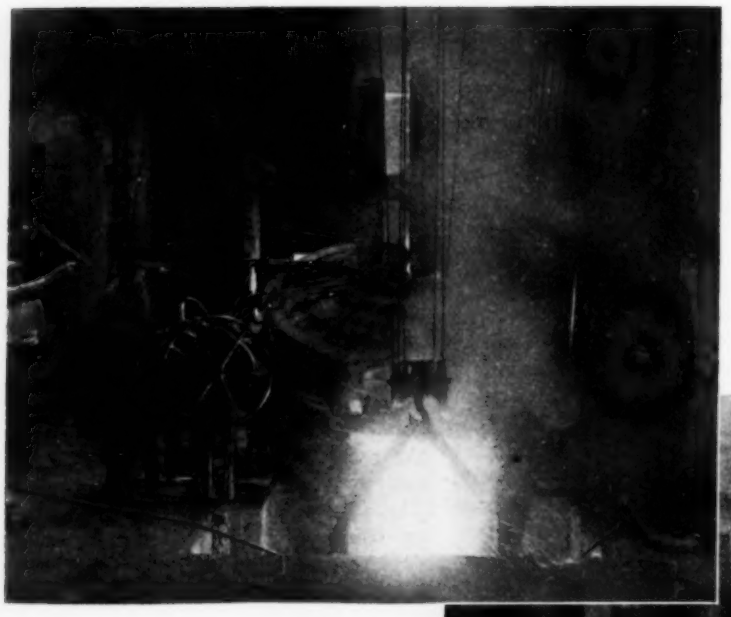
The writer has tried to bring out the following outstanding features in connection with the melting process of malleable iron with fuel and oil:

1. The absolute necessity of proper combustion and heat control.
2. Control of charge and elements, through desired oxidation, to insure uniformity of product.
3. Virtual control of element of time.
4. Decided economy of repair labor and costly materials in furnace maintenance.
5 Elimination to a greater extent of the human element in furnace operation.

A number of other important features are not covered in this article such as elimination of excess labor in furnace operation, handling of raw and waste materials and other items of a more or less degree of value. As indicated in the beginning, this paper has been written from facts and results obtained during a number of years of practical experience and laboratory research work.

Oil Burner Manufacturers Form Association

The American Association of Oil Burner Manufacturers, a national organization of both home and industrial oil burner manufacturers, recently was formed in Chicago. Disseminating accurate data concerning oil burning and the oil burner industry is one of the association's principal aims. Wallace C. Capen, Home Appliance Corp., St. Louis, was elected president; and Leod D. Becker, editor *Fuel Oil for Heat and Power*, Galesburg, Ill., was made acting secretary. Temporary headquarters will be maintained at 518 Bank of Galesburg building, Galesburg, Ill., and room 605, 20 E. Jackson boulevard, Chicago.



Adopts Melting Units to Meet Varied Needs

BY B. K. PRICE

WHEN the new and modern plant of the American Brakeshoe & Foundry Co., at Newark, N. J., was placed on the market last year without a casting having been poured, the Bayonne Steel Castings Co., Bayonne, N. J., effected a reorganization as the Eastern Steel Castings Co. and purchased the property. Completely equipped and recently placed in full operation, the plant is the largest steel jobbing foundry in the New York metropolitan district, and one of the few in the country producing both electric and open hearth steel castings.

While increased production was the primary consideration in the purchase of the plant by Eastern Steel Castings Co., another which was regarded as of hardly lesser importance was the opportunity offered to operate both open hearth and electric furnaces. Continued growth of the automotive industry, wider adoption of high speed production equipment, and broadening demand for labor saving machinery and road building equipment all contributed to a larger volume of demand. At the same time these factors have brought diversified requirements, and perhaps this diversity is more in evidence in the metropolitan district of New York than in any other section of the country.

Extensive Windows

The plant is located on an 8-acre site, and comprises fireproof buildings of brick and steel, with asbestos tile roofs. Ample light and ventilation are provided in each building by large steel-sash windows, elevated about 3½ feet above the floor and extending to the roof trusses, and by sash monitors in the roof. The top banks of the sash are top hung and may be controlled by an operating device in units up to 200 feet in length. Valleys in the center of the roofs, between the A-shaped monitors, act as deflectors for rising fumes or heat when the windows are open.

Sequence of Operation

The plant is U-shaped and consists of one main section of 33,000 square feet and two wings at right angles, each containing 20,400 square feet of floor space. By noting the floor plan, Fig. 2, it will be noted that the flow of work begins in the left wing, in which are located the electric steel foundry, core room and pattern shop. It then moves into the main building, where it is considerably augmented by work from the open hearth foundry, that occupies more than 80 per cent of the available floor space in this section. The remaining space is devoted to the annealing and grinding departments, through which all castings are passed. The greater portion of the product then is taken into the right wing to the grinding and shipping rooms.

Scrap, pig iron and other materials are brought into the storage yard in the rear of the plant on a standard gage track. The yard is approximately 650 feet long and varies in width to a maximum of 110 feet. It is served by a 5-ton electric crane, mounted on a runway, 35 feet high, and having a span of 95 feet. This crane may be equipped either with a magnet or bucket to serve the group of concrete sand and scrap bins or pig iron compartments in the rear and adjoining the electric steel and open hearth foundries. Each bin is 18 feet high and is provided with three 8 x 8-foot apertures in the roof through which material is lowered. The storage facilities are exceptional. The sand bins alone cover 6000 square feet and the pattern storage room, which is also in this general group, occupies two floors of 4800 square feet each.

Power Equipment

Power is provided by the company's own plant, adjacent to the right wing of the foundry proper. It is of brick and steel construction similar to that of the main building, 45 x 95 feet and approximately 24 feet high. It is equipped with a uniflow engine, direct connected with an alternating current 440 volt 450 kilowatt generator and one straight line engine.

Steam is furnished by two horizon-

FIG. 1—BROAD WELL-LIGHTED FLOOR SPACE IS AVAILABLE IN THE OPEN-HEARTH DEPARTMENT

tal, return tubular, oil-fired boilers, equipped with automatic stoking devices. The boilers are supplied with the circulating water from the open hearth furnace. By providing this method of supply, the company has been able greatly to reduce its monthly water bill. The water is given a temperature of 110 degrees Fahr. before it goes into the feed-water heaters installed, and a temperature of 210 degrees Fahr. before it goes into the boilers. Steam from the exhaust is used in the winter for heating. Horizontal tanks set well in the ground provide a storage capacity of about 55,000 gallons for the oil for the boilers and open hearth.

Supply Compressed Air

Two 875-cubic foot air compressors, driven by a 150-horsepower synchronizing motor, supply the compressed air for the day operations, a 6-inch air line running through the foundries distributing air to the pneumatic molding machines, chippers, hammers, open hearth, sand blast, etc. The working pressure is 95 to 100 pounds. To provide for night work and emergency service, a steam-driven air compressor with a capacity of 350 cubic feet per minute is being installed.

The castings made range from less than a pound to five tons in weight and include such work as general ma-

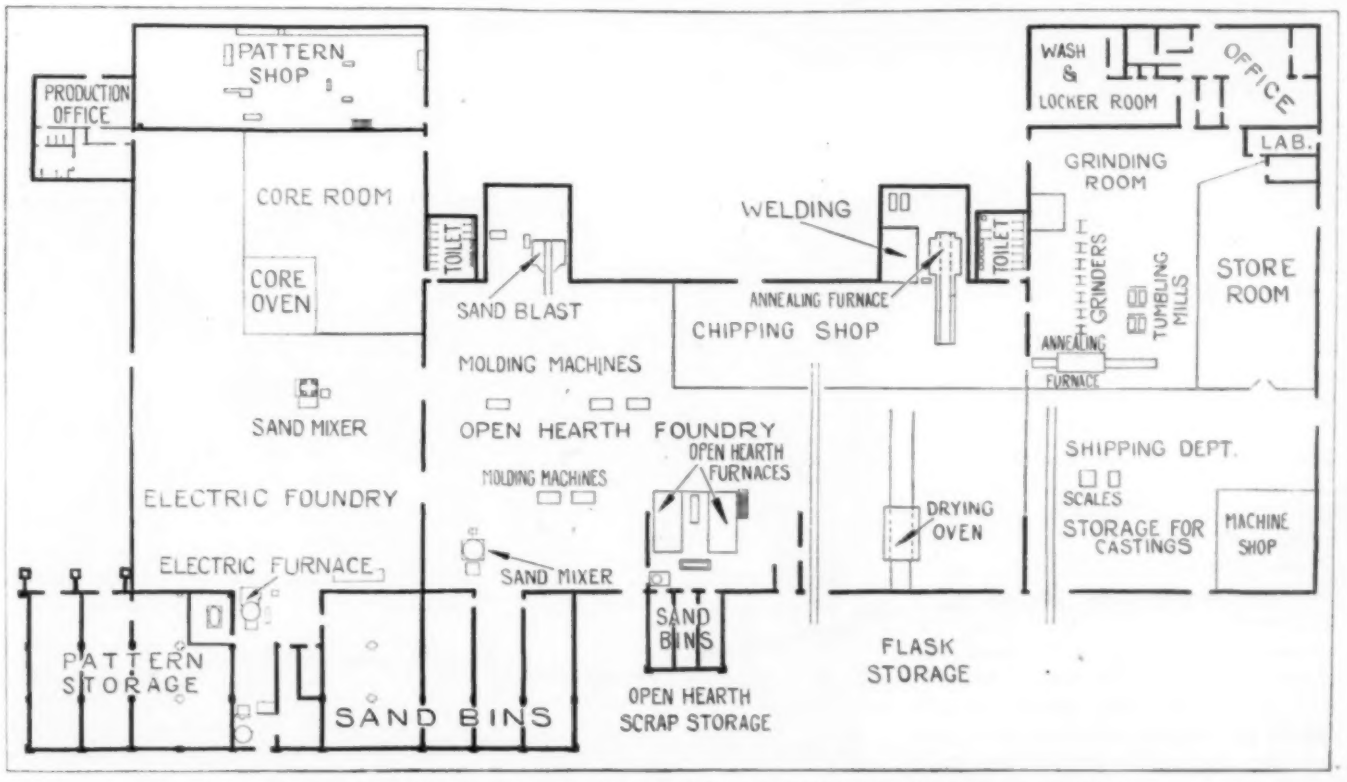


FIG. 2—GENERAL ARRANGEMENT OF THE EASTERN STEEL CASTINGS CO. FOUNDRY

chinery castings, motor frames, gears, gear blanks, automotive castings, headers for oil stills, railroad castings, steel valves and fittings, hydraulic pressure cylinders, bitts and mooring posts.

Every effort is made so far as possible to eliminate manual labor, possibly 60 per cent of the work in the aggregate being done by machinery. Work sheets enable the management, within practical limitations, to plot the order of work for several days ahead. In keeping the flow of work as even as possible, this practically eliminates any possibility of so-called tonnage work being pushed ahead at the expense of the other lighter and more intricate castings. The mechanical conveying equipment includes nine overhead cranes, of which six are electrically operated, and a number of automatic lift trucks.

The smaller castings, and in fact, practically all of the automotive castings, are produced in the electric foundry. This foundry comprises the greater portion of the left wing. A section of the molding floor is shown in Fig. 3. The steel is refined in a 3-phase furnace, set in the rear of the foundry. This furnace is shown on page 868. It has a rated hourly capacity of 1½ tons, turning out from 4000 to 4500 pounds per heat. The transformer is of 1000-kilowatt capacity, operating on 13,200 primary and 110 secondary voltage. It is located in a 16 x 20-foot room adjacent to furnace, as are also the electrode regulators and other furnace controls. The cooling water for the furnace is used over and over. Upon being run through the furnace, it is piped into a receiving basin into the ground outside the plant. The water is then forced by an electric pump to a cooling tower on the roof where it is again drawn upon for the furnace.

FIG. 4—OIL-SAND CORES ARE PREPARED IN A CORNER OF THE ELECTRIC SECTION

FIG. 3—SMALLER CASTINGS ARE MOLDED ADJACENT TO THE ELECTRIC FURNACE

The furnace operates entirely upon purchased scrap of low phosphorus and sulphur content, the foundry returns all being remelted in the open hearth furnace. The scrap is stored within easy access in reinforced concrete bins at the rear and to one side of the furnace. Material lowered through the apertures in the roof by the yard crane is always on hand in sufficient quantity to insure ample working stocks. The charge is fed into the furnace by a charging machine which is essentially a 1-ton scoop, mounted on trucks. It is lifted into position for charging by an air hoist. Scales are conveniently placed for weighing the charges.

From five to 10 heats a day are made. Each heat is poured into a 2-ton teapot ladle, which is transferred by a 6-ton, floor controlled electric crane, to the desired location for pouring into hand shanks. When empty, the ladle is conveyed by the

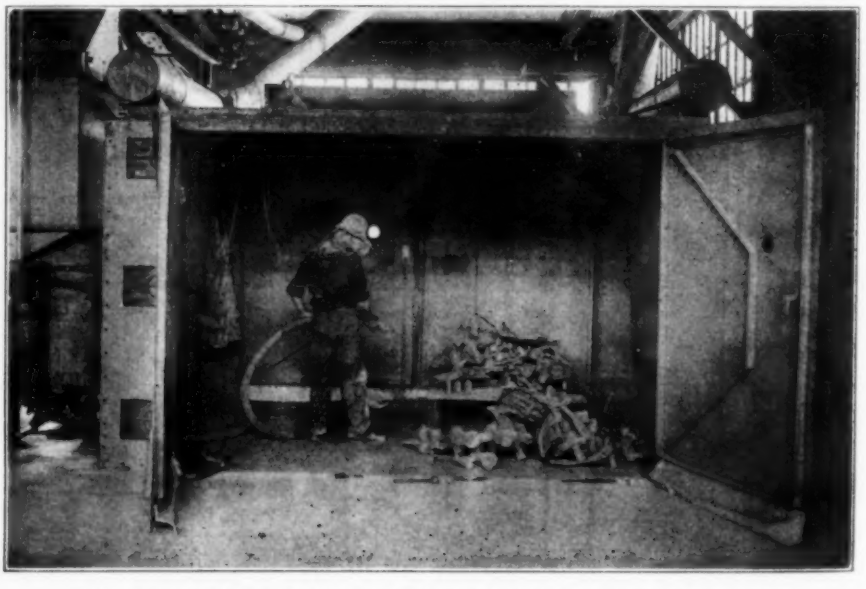


FIG. 5—COMPLETE SAND BLASTING FACILITIES ARE AVAILABLE

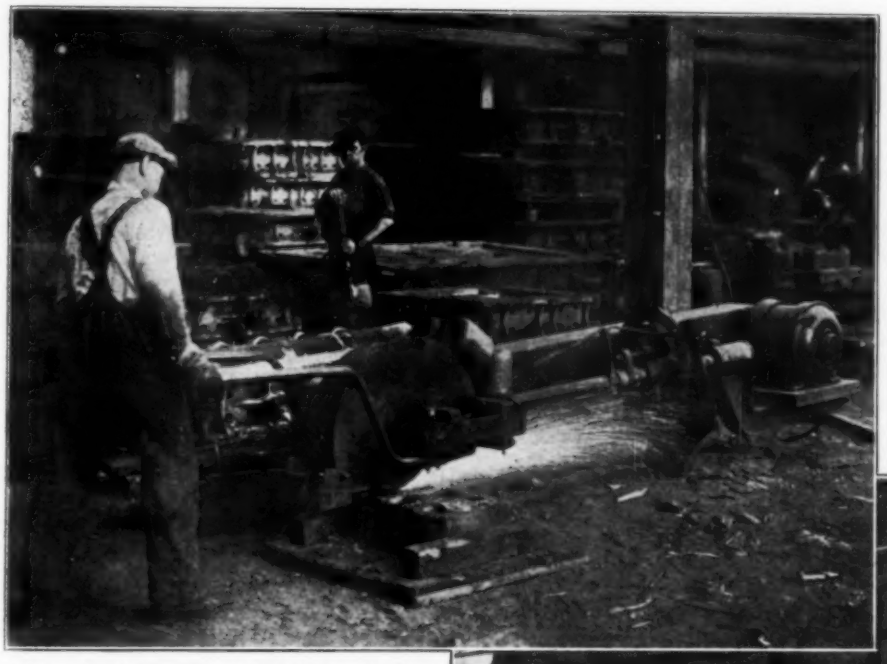


FIG. 6—LARGER CASTINGS ARE SNAGGED BY SWING GRINDERS

crane to an oil fired dryer installed at a convenient distance behind the furnace. The ladle is rested sideways on brick piers, with its top to the wall of the dryer through which is injected a fuel oil flame. However, it is set out from the wall a short distance to allow gases to escape. The small ladles are dried and kept warm between heats in a 4 x 4 x 20-foot brick oven, fed at each end by an oil burner. This oven has a capacity of 10 ladles.

Core and facing sand is prepared in a muller-type mixer of 1000 pounds capacity. It is fed by an elevating mechanism operated by an air hoist. After being mixed, the sand is carried away by lift trucks in portable, steel sand boxes so designed that the sand may be shoveled from the side.

Molding machines installed in the electric foundry include seven jolt strip squeezers, two jolt squeezers and four plain squeezers, all of which are arranged so as to provide ample floor space and light for the operators.

Oil sand cores are used and cores are made in a 6400-foot section of the left wing, adjoining the electric foundry. The cores are baked in a

FIG. 8—MOLDS ARE DRIED IN A CAR-TYPE OVEN

FIG. 7—SMALL CASTINGS ARE HANDLED ON A BATTERY OF STAND GRINDING WHEELS

battery of eight 7 x 5 x 12-foot, forced draft ovens, fired with coke. Fig. 4 illustrates the general layout of the core room, one end of the core ovens at the right.

The pattern shop is at the left occupying a space 60 x 80 feet, comprising the entire front of the left wing. Equipment is provided for 15 patternmakers and includes two band saws, a rip saw, jointer, planer and several lathes and sanders. A leanto to the left of the left wing houses the production offices.

The open hearth foundry, shown in Fig. 1 is supplied with metal by an

Makers of Principal Equipment

Equipment	Manufacturer	Address
Annealing Furnaces	Tate Jones Co.	New York
Air Compressors	Chicago Pneumatic Tool Co.	New York
Cranes	Pawling & Harnischfeger	Milwaukee
Dust Collecting System	Skinner Mfg. Co.	Elizabeth, N. J.
Ovens	F. A. Coleman Co.	Cleveland
	Holcroft & Co.	Detroit
Electric Furnace	Pittsburgh Elec. Furnace Corp.	Pittsburgh
Engine	Skinner Engine Co.	Erie, Pa.
Flasks	Truscon Steel Co.	Youngstown, O.
Fuel Oil Burners	John Foerst & Sons	Bayonne, N. J.
Fuel Oil Burning System	Preferred Utilities Corp.	New York
Generators	General Electric Co.	New York
Grinding Machines	Bridgeport Safety Emery Wheel Co.	Bridgeport, Conn.
	Safety Emery Wheel Co.	Springfield, O.
Industrial Trucks	Baker Truck Co.	Newark, N. J.
	Elevator Industrial Truck Co.	Brooklyn
Molding Machines	Osborn Mfg. Co.	Cleveland
Open-Hearth Furnace	Wm. Swindell & Bros.	Pittsburgh
Pattern Shop Equipment	Crescent Machine Co.	Leetonia, Ohio
	American Woodworking Machinery Co.	Rochester, N. Y.
	Oliver Machinery Co.	Grand Rapids, Mich.
Power Plant Boilers	D. M. Dillon Steam Boiler Works	Fitchburg, Mass.
Sand Blast	Pangborn Corp.	Hagerstown, Md.
Sand Mixers	National Engineering Co.	Chicago
Tumbling Barrels	W. W. Sly Co.	Cleveland

8-ton, acid-lined, oil-fired furnace, located in the center of one of the side bays. It is elevated sufficiently to accommodate the charging floor which is 11 feet, four inches above the floor level, and which extends several feet over the yard, facilitating the handling of scrap from the yard crane. The furnace is located in a section formerly occupied by the two 84-inch cupolas of the American Brakeshoe & Foundry Co. later sold to the Central Foundry Co. and to make this latest installation it was necessary to cut away one floor elevation entirely and to lower what is now the charging floor about 7 feet.

Handling the Iron

The furnace has a daily capacity of five heats. These heats are tapped into two 10-ton ladles, which are conveyed over the molding floor by two 10-ton electric cranes with spans of 38 feet. The pig iron used is of low phosphorus content, and comprises about 10 per cent of the charge. Pouring metal into the molds is illustrated at the head of the article. The ladles are heated by fuel oil burners.

Practically 50 per cent of the molding in the open hearth foundry is done by machinery, which includes three jolt rollover, pattern draws, and two plain jolt machines. The latter are used largely for special railroad work. The pattern draw machines are served within a limited area by floor controlled 2-ton cranes, of 38-foot span, as are also the plain jolting machines located in one of the wide wings.

The completed molds are taken either to the drying oven or casting floor by the two 10-ton cranes, which cover the entire length of the building. Those to be dried are baked for approximately 10 hours in a coke-fired oven shown in Fig. 8. Those taken to the casting floor are closed immediately and poured.

Facing is prepared in a muller type mixer, equipped with an 8-foot pan of approximately 2200 pounds capacity. Sand is placed in the bin by a 1-cubic yard bucket, elevated between two columns by an electric hoist. The bucket is especially designed, being rectangular in shape at the top, with the side farthest from the mixer sloping at a sufficient angle to deflect the sand which is discharged from the bottom, through an automatic slot. For filling the bucket rests in a pit with the top on a level with the floor, so that the sand may be poured in directly from the conveyors.

The castings in the open hearth foundry are all shaken out at night. The shakeout sand is dampened down, cut and handled by a clamshell bucket hoist which distributes it for further use.

The sand blast department occupies a 1600 square foot leanto off one of the side bays of the open hearth foundry, near the left wing. In this section is a 12 x 12-foot sand blast cabinet, Fig. 5, to which the castings are sent either on skids or industrial flat cars, the latter running on a narrow gage track. A downdraft ventilating system, operating through a grating in the floor, carries out the dust-laden atmosphere, this feature, in conjunction with a well-appointed lighting system enabling the operator to see his work distinctly at all times. The sand blast sand is reclaimed by an automatic unit included in the cabinet installation.

From this section the castings are passed either to the sprue cutter installed in the room, or to the acetylene torches, where the heads and gates are burned off in the event they are too large for the machine.

Large Working Area

The chipping shop occupies the major portion of the side bay adjoining the sand blast room. A section of this shop is illustrated in Fig. 9, one of the two welding cabinets being shown in the rear. The illustration sets forth clearly the range of some of the larger castings produced at this plant. The location of the chipping shop in relation to the open hearth foundry is better shown by Fig. 2, the shop being in the bay at the left.

Here a special point was made to provide a large working area so as to eliminate the necessity for piling the castings, which often results in work being run out of scheduled order. To facilitate distribution, a 5-ton electric overhead crane, with a 38-foot span, is installed, commanding

(*Concluded on Page* 883)

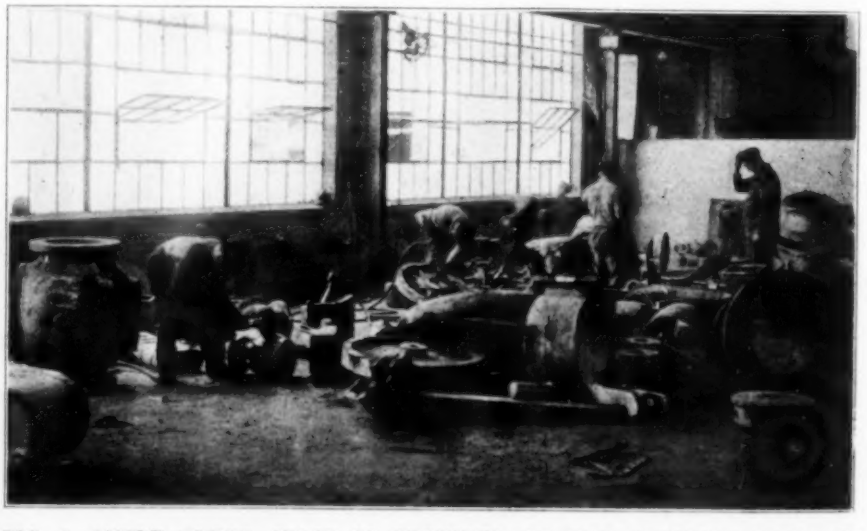


FIG. 9—AMPLE FLOOR SPACE IS PROVIDED IN THE CHIPPING ROOM TO ASSURE HANDLING CASTINGS IS REGULAR SEQUENCE

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

CONTRACTION OF LIGHT ALUMINUM ALLOYS

(Continued from Data Sheet No. 498)

Effect of Manganese—Manganese has a pronounced effect to increase the contraction of light aluminum alloys. An addition of 1.5 per cent manganese to aluminum decreases the contraction only slightly, while manganese when added to aluminum-copper and aluminum-zinc alloys increases the contraction markedly. The following table gives some comparative figures.

Linear contraction of manganese-containing aluminum alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Linear Contraction Patternmaker's Inch per foot	Scale	Per cent
1	100 Al	0.198	1/60	1.65
9	98:5:1.5 Al-Mn	0.193	1/61	1.61
3	92:8 Al-Cu	0.161	1/74	1.34
22	90:8:2 Al-Cu-Mn	0.168	1/70	1.40
6	86:14 Al-Cu	0.144	1/82	1.20
23	85:14:1 Al-Cu-Mn	0.151	1/78	1.26
16	67:33 Al-Zn	0.114	1/104	0.95
34	66:1:33 Al-Mn-Zn	0.133	1/89	1.11

Effect of Nickel—The effect of nickel on the contraction of aluminum is not so marked as that of copper, and its effects upon aluminum-copper alloys are variable, apparently depending upon the composition. The following table gives some comparative figures.

Linear contraction of some nickel-containing aluminum alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Linear Contraction Patternmaker's Inch per foot	Scale	Per cent
1	100 Al	0.198	1/60	1.65
10	92:8 Al-Ni	0.170	1/69	1.42
3	92:8 Al-Cu	0.161	1/74	1.34
24	90:8:2 Al-Cu-Ni	0.150	1/79	1.25
6	86:14 Al-Cu	0.144	1/82	1.20
25	85:14:1 Al-Cu-Ni	0.149	1/80	1.24

(Continued on Data Sheet No. 500)

CONTRACTION OF LIGHT ALUMINUM ALLOYS

(Continued from Data Sheet No. 499)

Effect of Silicon—Silicon has remarkable effects in decreasing the contraction of aluminum and its alloys. When added to aluminum, 3 per cent silicon reduces the contraction from 1.65 per cent to 1.28 per cent, and 10 per cent silicon reduces it to 1.11 per cent. Some comparative figures are given in the following table.

Linear contraction of some silicon-containing aluminum alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Linear Contraction Patternmaker's Inch per foot	Scale	Per cent
1	100 Al	0.198	1/60	1.65
11	93:7 Al-Si	0.154	1/77	1.28
12	90:10 Al-Si	0.133	1/89	1.11
6	92:8 Al-Cu	0.161	1/74	1.34
26	90:8:2 Al-Cu-Si	0.140	1/84	1.17

Effect of Tin—Tin reduces the contraction of aluminum, but its effect is not quite so pronounced as that of copper. Tin also reduces the contraction of aluminum-copper alloys. Some comparative figures are given in the following table.

Linear contraction of some tin-containing aluminum alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Linear Contraction Patternmaker's Inch per foot	Scale	Per cent
1	100 Al	0.198	1/60	1.65
13	92:8 Al-Sn	0.166	1/71	1.38
3	92:8 Al-Cu	0.161	1/74	1.34
27	90:8:2 Al-Cu-Sn	0.151	1/78	1.26
28	88:8:4 Al-Cu-Sn	0.149	1/80	1.24
29	85:5:10 Al-Cu-Sn	0.149	1/80	1.24

(Continued on Data Sheet No. 501)

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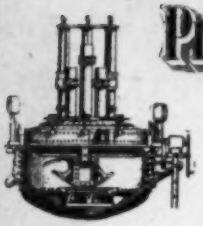

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UNION BANK BUILDING
GENERAL OFFICES
PITTSBURGH, PENNA., U.S.A.

MOORE RAPID Tectromelt FURNACE
FOR STEEL, FINE CAST AND MALLEABLE IRON, BRASS, BRONZE, NON-FERROUS ALLOYS, CALCIUM CARBIDE, ETC.

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The Penton Publishing Co.,
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Gentlemen:-

We depend primarily on THE FOUNDRY to keep the Tectromelt furnace before the iron and steel foundrymen, as we feel it covers this field most thoroughly. We receive many inquiries for Tectromelt furnaces which refer directly to THE FOUNDRY as creating their interest.

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J. F. Baker.
J. F. BAKER.

JFB:FL

Urges Use of Nickel Alloys

Methods of Making Pure Nickel Make Possible Alloys With Other Nonferrous Metals Remarkable For Their Great Strength and Ductility—Casting Qualities of Nickel Govern Alloy Content

AMONG the vast number of modern alloys there are few in the opinion of W. R. Barclay of Henry Wiggin & Co., Birmingham, Eng., which offer better opportunities for the study of casting and rolling problems than nickel alloys. In spite of the difficulties involved in making nickel castings they nearly always have repaid care, but the characteristic susceptibility of nickel to relatively small differences in casting temperature and the appreciable influence of small amounts of impurities make it difficult to handle in a foundry.

The history of the use of nickel for industrial purposes is short in comparison with that of other nonferrous metals. Until the discovery of recent methods of refining the metal, it was rarely obtainable at a standard of even 98 per cent purity. Generally it was lower than 96 per cent pure. The processes of producing or refining nickel at the present time all achieve a high degree of purity. Electrolytic processes are used extensively, but the purest nickel from a refinery would not have the properties of malleability and ductility credited to it, if it were not for Fleitmann's discovery that nickel can be deoxidized by the use of magnesium.

Because of this, pure nickel in the form of sheets, rods, wires, tubes, and drop forgings is available for the metal industry. In addition to the difficulties of melting and casting a metal with such a high melting point, 1450 degrees Cent., the susceptibility of nickel to nonmetallic elements like sulphur and carbon is also troublesome. The difficulty with carbon is characteristic. If it is entirely absent the material becomes oxidized and is extremely difficult to cast in a sound condition either in chill or sand mold. If it is in excess the metal is hard and develops brittleness in hot and cold working. Malleable nickel cannot contain less than 0.05 per cent carbon nor more than 0.15 to 0.20 per cent. Carbon in nickel over 0.3 or 0.4 per cent has been found to separate as free graphite with the resulting brittleness in the nickel structure.

Whatever type of furnace is used in melting nickel, its first essential is the ability to reach 1650 degrees Cent. without difficulty or delay. In a coke-fired crucible, steel furnace, the average time of melting being three hours, successful results have been obtained. The ideal furnace for melting nickel is the electric furnace, and at present the arc type seems to be favored. The only danger is the possibility of the metal absorbing the carbon from the electrodes, but this can be guarded against by keeping the metal covered with slag. When properly oxidized and produced in sound chill castings, the rolling and forging properties are satisfactory.

Nickel Like Man

THE author suggests the analogy between nickel and an ideal man. He says, it will work singly if called upon, and play no mean part when it stands alone and as an individual; but it will work still better in company with its metallurgical friends with few of which it will quarrel and with most of which it will form a perfect bond of union, so serving its day and generation with still greater faithfulness. Finally, it will cover the defects of its less fortunate fellows, and in so doing impart its own merits to its meanest kin.

Resists Action of Acids

The chemical properties of nickel are of extreme importance from an industrial point of view. It has a high resistivity to attack by air and water and should be taken into consideration in solving the problem of corrosion. The relatively great resistance of nickel to corrosion by the organic acids and by action of food stuffs has led to its adoption for cooking and dairy utensils. Its hardness, brilliance and resistance to abrasives put it in a favored class when compared with aluminum and copper.

Prior to and during the World war the greatest single use of nickel was as a component of alloy steels. At the present time the position seems to be changing and a greater percentage is being used in the nonferrous industries. Before 1917 only about 5 per cent of the nickel production was consumed as pure or malleable nickel while over 90 per cent was consumed annually in the making of alloys, ferrous and nonferrous.

The first place among nickel nonferrous alloys is occupied by the copper series. Bacterian coins dating back to 231 B. C., containing 78 per cent copper and 22 per cent nickel have been found. In nickel-copper alloys the two elements form a single series of solid solutions in all proportions. From a purely practical standpoint any proportion of copper and nickel will give a workable alloy and all possess useful physical, mechanical and chemical properties. Nickel exerts a marked influence on copper even when present only in small proportions In 1912 Bauke showed that the resistance of pure copper to impact tests was actually doubled by an addition of less than 2 per cent of nickel. Nickel in the proportion of 15 per cent completely decolorizes the copper and the result is a white metal. The main commercial alloys are 95 copper-5 nickel; 85 copper-15 nickel; 80 copper-20 nickel; 75 copper-25 nickel; 60 copper-40 nickel and 30 copper-70 nickel. The 80-20 alloy, called cupro-nickel is noted for its ductility, malleability, and beauty of color. It is rare to find a nonferrous alloy not containing nickel which in a casting will give a maximum stress value of aproximately 90,000 pounds per square inch, and in the few cases where this figure is approached, the ductility usually is low. This strength is easily reached in some nickel alloys, which are malleable, ductile and stand up under stress at high temperatures remarkably well.

The copper-nickel alloys of considerable engineering value are not necessarily those composed mainly of copper. The most conspicuous example of this form of alloy is monel metal. Being an intermediate product in the refining of nickel-copper matte worked up to a rich nickel content mixture, oxidized, and then reduced to a metal, it contains many impurities such as iron or silicon. Its approximate composition is 67 per cent nickel, 28 per cent copper, and 5 per cent other metals.

Among the alloys to find their way recently into industrial use is the nickel manganese series. Although these alloys have received little attention from metallurgists up to the present time, they give indications of being soluble in all proportions in both solid and liquid states. Though only a few of them have been

Abstracted from a paper delivered at a meeting of the Birmingham, England, local section of the Institute of Metals. The author, W. R. Barclay, who was formerly one of the advisors to the ministry of munitions, is a director of Henry Wiggin & Co., recently amalgamated with the Mond Nickel Co.

examined two alloys containing 3 and 4½ per cent manganese respectively have received considerable attention. The use of nickel with chromium is also of industrial importance because of the resulting strength at high temperatures and resistance to corrosion. Several of these alloys are covered by patents in the United States and Europe. The ternary alloy of nickel, iron and chromium is of importance, but it has been found incapable of withstanding successfully a temperature of 1000 degrees Cent. The use of nickel in the manufacture of brass is also of interest from a metallurgical standpoint and comparatively few high tensile brasses are now made without it.

The mechanical and physical properties of pure nickel cold worked and annealed are increased also. According to Price and Davidson the effect of annealing appears to begin at 650 degrees Cent. and further heating over 850 degrees has little effect. The tensile strength is increased to 112,000 pounds per square inch by cold working. By controlling the carbon content of almost pure metal, or by means of alloys, practically any previously attained degree of hardness and tensile strength may be reached.

Consider Specifications

REPRESENTATIVES of the principal producers of merchant pig iron in France, Belgium, and Luxembourg met Walter Wood representing the American Society for Testing Materials at the offices of the Comite des Forges recently to discuss the standardization of French export pig iron according to analysis.

After considering the proposals of Mr. Wood, who suggested the adoption of the standard specifications for pig iron of the American Society for Testing Materials, the French manufacturers decided to submit counter proposals. The suggestions recommend a permissible variation in silicon contents of 0.7 to 0.8 per cent instead of 0.25 per cent as provided by the A. S. T. M. specifications. The French proposals also suggest phosphorus variations of 0.4 to 0.5 per cent instead of 0.15 per cent and manganese variations of 0.25 per cent instead of 0.20. In most other particulars the French proposals agree fairly closely with the standard specifications of the A. S. T. M. It is expected that the French producers will adopt these suggestions and that commencing early next year French export pig iron will be sold according to these recommendations, although some further negotiations with reference to permissible variations in silicon, phosphorus, etc., may take place after Mr. Wood returns to the United States.

A meeting was also held in London recently at the offices of the National Federation of Iron and Steel Manufacturers to consider the question of standardizing English export pig iron according to analysis. Most of the British producers were represented and with one or two exceptions agreement was expressed with the principle of selling by analysis. One important British exporter with headquarters in Middlesbrough, however, stated that under no circumstances would it sell except by fracture grading. The British producers took no definite action with reference to the adoption of the A S. T. M. specifications.

Project for Supplying French Phosphorous and Semi-Phosphorous Pig Iron for Exportation Sale

After examination of the recommendations proposed by Mr. Wood and Dr. Moldenke, the French phosphorous and semi-phosphorous pig iron producers propose for the same paragraphs, the following wording.

1. MANUFACTURE

The pig iron shall be clean, as free as possible from dross and sand, and may be either machine or sand cast.

2. CHEMICAL PROPERTIES

a) The pig iron shall conform to the chemical requirements specified by the purchaser at the time of purchase, with the following permissible variations from the specified percentages in the case of pig iron intended for the manufacture of gray iron castings :

Silicon . . . . { 3.0 to 3.8 o/o. / 2.5 to 3.2 o/o. / 2.0 to 2.7 o/o. / 1.5 to 2.2 o/o. / 0.8 to 1.7 o/o.

Sulphur . . . Maximum admissible for furnishing will be specified in the contract.

Phosphorus . . { 1.5 to 2 o/o. / 1.0 to 1.5 o/o. / 0.6 to 1 o/o.

Manganese . . 0.3 to 0.8 o/o with tolerance of 0,25 more or less on the figure fixed in the contract.

b) For hematite iron, malleable iron and all other special irons (such as, for example, *phosphorous* iron and extra siliculous 3,6 to 4,2 o/o and 4 to 4,8 o/o) the producers giving all desirable attention to any special conditions proposed to them by the buyers.

3. SAMPLING AND ANALYSIS

a) For taking samples, a lot corresponding to the maximum weight of 50 tons shall be considered a unit.

b) A test will be taken on each 5 tons of the lot in such a way that the sample will represent the average quality of the iron.

c) The pigs thus taken shall be broken in the middle and drilled through the center of the section.

d) The drillings thus obtained shall be mixed-an equal weight from each sample so as to make up the sample to be submit ed for analysis.

4. INSPECTION AND REJECTION

In case of dispute, the sampling and analysis shall be made by an independint chemist, mutually agreed upon (if possible when the contract was made) whose decision shall be final. The cost of such re-sampling and re-analysis shall be borne by the party in error.

All pig iron which fails to conform to these specifications shall be subject to rejection.

No pig iron can be refused after its departure from the works.

CHANGES PROPOSED IN THE SUGGESTIONS OFFERED FRENCH PIG IRON PRODUCERS

The name of the Republic Radiator Corp., Utica, N. Y., has been changed to the Lincoln Radiator Corp. No change is made in the officers or personnel of the organization.

Sterling Brass Products Co., 18 Lyon street, Worcester, Mass., recently has been organized to manufacture plumbing fixtures.

The Gibb Instrument Co., Bay City Mich., announces the appointment of H. A. Wilson as manager of its Detroit branch in place of F. M. Lyche, resigned. Mr. Wilson formerly was district manager in New York for A. P. Munning & Co.

Preparations for the opening of the Electric Auto Light foundry, near the main plant in the north end of Fostoria, O., are being pushed. J. R. Lester is the superintendent.

How and Why in Brass Founding

By Charles Vickers

Using Scrap Mixtures

We are having difficulty using our scrap, gates, sprues and so forth on account of the castings not being free of porosity. We melt in a crucible furnace, with gas as fuel, and use a No. 60 crucible with a charge as follows: Copper, 60 pounds; scrap brass, 50 pounds; zinc, 40 pounds. We use no covering on the metal and no fluxes. Our sand is No. 2 nickel plate, Sandusky sand, and the weight of the castings varies from 5 to 20 pounds each.

The alloy is too high in zinc to make good castings. The scrap brass is an unknown quantity, but supposing it to consist of good sheet yellow scrap; about a 70-30, the mixture being used would contain nearly 37 per cent of zinc, or 10 per cent more zinc than it should contain.

The high zinc content makes it almost impossible to run perfect castings, but added to this is the fact of the melting being done without flux or charcoal covering of any kind. The only flux needed on that kind of brass is charcoal and charcoal is only a covering. We suggest that charcoal be freely used on the metal provided it can be held there; but if not, then a flux of some kind is absolutely necessary and if the charcoal covering fails owing to the blast burning it up, or blowing it away, we shall be pleased to suggest something in the nature of a flux.

Be reducing the zinc content and covering the metal while it is being melted, there should be no more difficulty in getting satisfactory castings.

Aluminum Not Susceptible To Color Changes

How can we alloy aluminum to produce a black metal, not only on the surface, but all the way through?

You cannot produce an alloy of that character. We know of no metal dead black when cut. Even silicon, a dark metal is not black but violet and it is too hard and brittle to be used alone except for cast utensils for certain chemicals and there it resembles porcelain. When alloyed, as it is frequently up to 14 per cent with aluminum the alloy still is the color of aluminum. Aluminum is not susceptible to change in color either superficially or by alloying. It is a strong decolorizer of other metals and 5 per cent or even less will destroy entirely the red color of copper.

Brass can be colored a permanent black, but it is only a surface discoloration. Examples of this kind of work may be seen in telephone instruments where it will be noted the color stands handling, and wears well. It is produced by a black nickel deposit. Unfortunately, aluminum is not readily plated with any metal, otherwise it could be copper plated and the desired color could be brought out on the copper.

Suitable Aluminum Alloy for Frying Pans

We are contemplating the manufacture of aluminum frying pans and griddles and as they have to be made as cheaply as possible we shall appreciate your advice on the best alloy to use, the best gating system to employ and whether or not these castings can be made in permanent molds. We have in mind an alloy made up of zinc 15 per cent, copper 3 per cent and aluminum 82 per cent.

We believe the standard alloy known as No. 12 would suit your purpose better than the alloy you have in mind. It contains 8 per cent copper and 92 per cent aluminum. If a more ductile metal is considered necessary the copper may be reduced and the aluminum increased proportionally. For example, copper 5 per cent and aluminum 95 per cent makes a suitable alloy of this kind.

The pan is molded bottom up and poured through a finger gate connected to a pouring basin. The fingers are approximately the size of a lead pencil and the number will depend on the size of the pan. A medium size pan may be poured through 5 fingers. The casting, of course, might be made in a permanent mold. Many more complicated castings are made in this manner. However, the popular conception of a permanent mold, bears little resemblance to the exceedingly expensive and elaborate devices actually in use. Unless expert knowledge of the molds and their manipulation is available we suggest that you adhere to the ordinary sand casting method.

You state that the job is cheap, but you also may have noted that the pan commands a respectable price before it finally is delivered at the kitchen door. The foundryman makes the casting, but apparently some other person makes the money. We suggest that you figure the job carefully over again and if you see no prospect of making any money, turn the job over to any person foolish enough to make a donation of his time and materials to same shrewd customer.

Valves for Superheated Steam Line

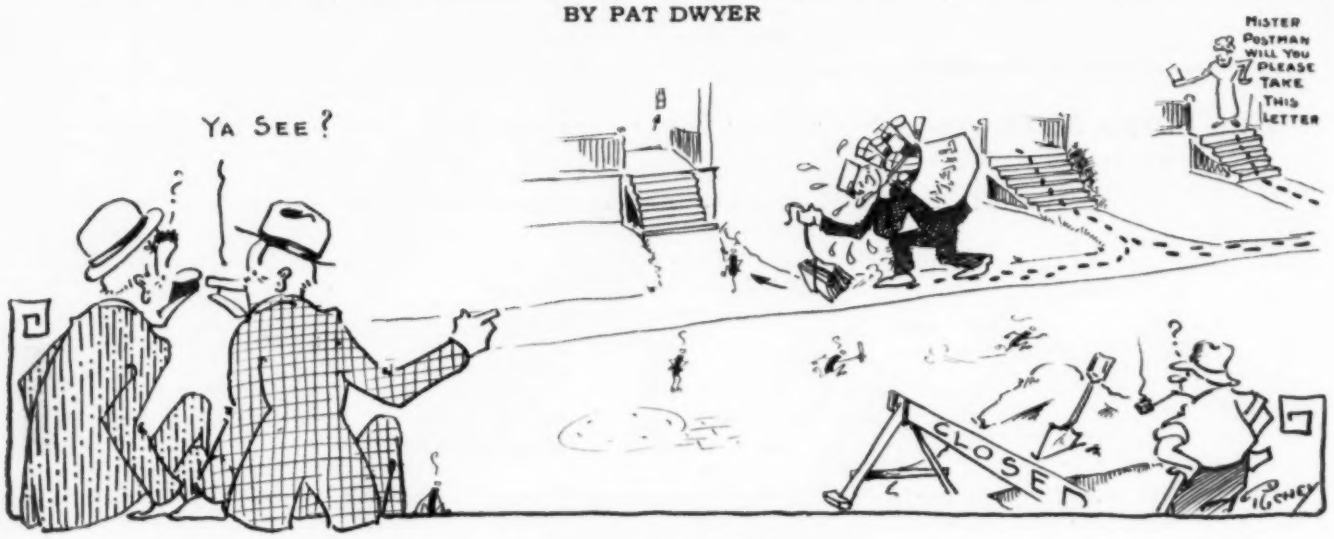
We are trying to develop an alloy suitable for valve seats used in connection with high pressure superheated steam. We analyzed a casting already on the market and found that it was made up of copper 65 per cent and nickel 35 per cent. This metal machined freely, but when we made castings from the same formula the metal was too hard to machine. Later we experimented with an alloy made up of nickel 35 per cent, tin 4 per cent, lead 1 per cent, copper 60 per cent and traces of phosphorus and silicon. This metal also is too hard and brittle. We shall appreciate your suggestion on what to add to the 35 per cent nickel and 65 per cent copper alloy, so that we may machine it readily, including the cutting of fine threads on automatic machines. The alloy must not contain lead, zinc or other element that might cause deterioration.

Suggestions for additions to the alloy in question can not be made off hand, but only are possible after much careful study and time consuming inventive effort. We suggest you continue your experiments and refuse to be discouraged by one or two failures. Many disappointments are inevitable and have been experienced by every pioneer in the alloy field. However, you will experience more satisfaction in developing an alloy of your own.

If you *have* to duplicate the 35-65 alloy, try once more and if after observing all necessary precautions, the result is the same as before, then you should enlist the service of a chemist. Have your metal analyzed and by a comparison with the anticipated analysis you may find the clue to your trouble. After a few trials you should be in a position to produce a metal with all the characteristics of the original. In our opinion something else besides nickel 35 per cent and copper 65 per cent is present. This mixture while not *hard*, certainly is too tough to be machined easily in a turret lathe no matter who makes it or where it is made.

Bill on Egyptian and Other Pyramids

BY PAT DWYER



AS A citizen, and more or less willing tax payer, you doubtless often have wondered how the post office department manages to stagger along under the millions of pieces of superfluous matter it is forced to handle every day. As a general rule I have not much sympathy for the long haired and wild eyed members of reform associations, but any time a society is organized for the Amelioration of the Lot of Unfortunate Letter Carriers I shall be pleased to lend any measure of moral support that lies in my power.

Whenever I see one of these faithful beasts of burden, creeping along, bowed under a load that would tax the patience and lifting capacity of a Texas mule, I marvel at the apparent ignorance and lack of observation displayed on the part of the man who coined the famous foundry phrase dealing with a weak head and a strong back.

My private and personal opinion is that any molder who attempted a letter carriers job would be yelling for a *hold up* half way down the gangway.

Some time ago we heard of a great deal about a bureau to be organized under government auspices for the elimination of waste in industry. If I am in order—hearing no expression of opinion to the contrary, I assume that I am in order—I should like to make a modest suggestion to the effect that the bureau devote some attention to this neglected field and devise a method for ditching a lot of the junk usually sent through the mails. One morning recently I sat in the office of the general manager of a big company while he plowed through the mail. Some letters he read all the way through, others he merely glanced at the top and the bottom and a considerable number were thrown in the waste paper basket without even going through the formality of being opened. I expressed surprise and admiration at the celerity with which he handled the job, Also, I began to have a dim perception of how he found time to handle the endless mass of detail that occupied his time every day. He explained his method briefly. Doubtless he exaggerated a trifle for he was not talking for publication and besides he sometimes relaxes and indulges in that peculiar form of indoor sport referred to on the other side of the jolly old pond as spoofing.

"System, my boy, system" he said. "I read the first letter, look at the second and invariably throw the third letter in the waste basket."

Simple, eh! what?

When compared with the volume of mail delivered every morning at the palatial residences of movie stars, near stars and other really important people, the modest share that comes my way is not alarming and up to the present I have experienced no particular difficulty in disposing of it without enlisting the services of a trained helper or without adopting any short cut methods.

IT'S EASY WHEN YOU KNOW HOW

An interesting folder fluttered in the other morning extolling the virtues of a certain oil and incidentally tracing the history of petroleum back to a time about which even the Book of Genesis is rather vague. I was not particularly interested in oil—coal oil, hair oil or castor oil, or any kind of oil—but my attention was arrested by the illustration and text describing how the pyramids of Egypt were built under the direction of the Pharaohs.

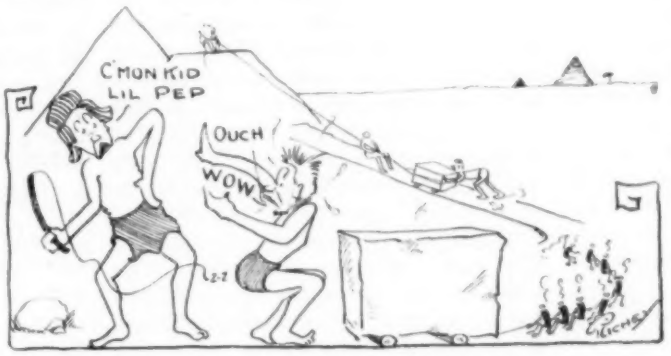
The author of the sketch quoted the familiar theory to the effect that the stones were quarried at a considerable distance and then conveyed on rollers to their destination in the silent valley of the Nile. The first tier was arranged on the ground true and level and with each of the four sides pointing to one of the four cardinal points of the compass. Succeeding tiers were raised to their places by first building long inclined planes.

Heavily whiskered scientists and others who go in more for what may be referred to as the light or semi-whisker school, have discovered and passed on to a breathless public, statistics to the effect that 100,000 men were employed for at least 20 years in building one of these useless rock piles. Stories have been written in which the pyramids have figured and almost invariably the author has pulled the cork out of his or her bottle of pathos and with quivering under lip bade us observe the merciless manner in which the cruel overseers wielded the whips over the bare legs and backs of the toiling, straining, sweating files of slaves yoked to the drag lines. With a view of getting an impartial, modern slant from an ordinary citizen on the situation I asked Bill if

he ever had allowed his imagination to dwell on the subject.

"Many times," said Bill. "I never placed any great amount of faith in that theory of the long inclined plane. However, for want of a better I was forced to accept it until one day a friend in the building and general contracting business exploded the old myth. He explained that in his opinion the pyramids were built of concrete. Those cute little Egyptian lads built the forms in the shape of large cut stone blocks, poured the concrete, allowed it to set and then built other blocks on top and so on until the pyramid was completed." "You do not need to go back 5000 years," he continued, " to find examples of secret processes. You can find them in any number in the foundry industry in our own day and generation. They are secret, in many instances not because individual foundrymen are averse to giving them out, but because other foundrymen either lack the necessary curiosity to seek knowledge or, because they lack the necessary ability to add two and two together to make four after certain secrets have been explained to them either in whole or in part. It is quite true that in some shops visitors are welcomed about as cordially as the smallpox or the Asiatic cholera. I trust you will not take the phrase and interpret it to mean that I include all visitors. I am talking specifically about the dissemination of information and the reference, of course, only was intended to include visitors who come with the purpose, either open or implied, of examining methods, materials and processes.

"It is a sad commentary on the mental qualification of the workmen employed in these shops that apparently the managers pay no attention to the possibility of these men acquiring the secrets and taking them elsewhere when they resign their positions either voluntarily or involuntarily. I suppose I should say when they quit or get fired, but you know the experience of getting severed from the payroll usually is a delicate and sometimes painful operation and if the substitution of the term *resign* for *fired* will bring a ray of sunlight into an otherwise dark situation, why I think it nothing less than our duty to employ it on very reasonable occasion. In fact I might go further and urge its use even upon unreasonable occasions. One at least will have the consolation of knowing that he is not establishing a precedent. It has been done.



ORIGIN OF THE GOOD OLD COLLEGE GLEE: MERRILY WE ROLL ALONG

"The claim has been advanced that ordinary workmen, as a class, are non-observant. They perform a given task day in and day out and rarely, trouble their minds with the details of the equipment with which they are furnished, or the peculiarities of the materials which they use. This feature is recognized to such an extent that the probability of workmen stealing secrets or capitalizing on them elsewhere is considered an almost negligible factor.

"Exceptions occasionally are noted, but they form such an insignificant percentage that they simply serve to accentuate the truth of the general rule.

"Theoretical gentlemen, actuated by the purest motives and therefore capable of exerting no influence either for good or evil, on the one side, and intensely practical gentlemen with large, broad-bladed, double bitted axes to grind, on the other side, have delved into the subject from time to time. With little or no provocation in some cases they have presented their findings through a sympathetic press which usually succeeds in garbling the message. Newspapers, as you probably have noted, place what they are pleased to term reader interest above accuracy and any person who ever worked on a newspaper knows that the rewrite man sitting at his desk is in a better position to describe any act or event than the original writer who actually witnessed the same thing with his own eyes, or had access to original sources of information.

"The great reading public devours the thrilling version in the usual hurried manner, skips a paragraph here and there and on the following day either has forgotten all about it, or does not know whether it is going or coming. It is by no means an uncommon occurence for two representative citizens to read the same identical story in duplicate copies of the same edition of the same paper and afterward arrive at diametrically opposed conclusions.

"For example, I have known two esteemed citizens to read the story of a murder trial. The first citizen gathered the impression, which no amount of argument could shake, that the prisoner was absolutely innocent and simply was the unfortunate victim of cruel and untoward circumstances. The second man was so certain of the defendant's guilt that he characterized the trial as a useless and totally unnecessary formality and an unwarranted expenditure of the tax payers' money. If he had his way, which simply was another way of saying that if he had lived a few hundred years ago and was in a position to exercise the high justice, the middle and the low, he would take the prisoner down to the pier in front of the sewage reduction plant, tie an old worn out grindstone around his neck and throw him into the lake without benefit of clergy or the melancholy consolation of bell, book and candle.

WHEN SHE RUNS OUT OF BREATH—AND WORDS—SHE WILL MAKE SIGNS TO INDICATE THAT SHE WANTS TO BE SET ASHORE, INSTANTLY, ANY PLACE WHERE SHE NO LONGER CAN SEE HIM

"As you were!" I felt impelled to interject at this point. "Attention! or whatever the proper term happens to be. Perhaps Whoa! would be the most appropriate under the circumstances. What I mean to say is, come out of the woods and for the love of Maryanne and other well known heroines of the golden age of chivalry get your big, flat feet back on the path. What, in the name of the screaming American eagle has a newspaper story of a murder trial to do with foundrymen who muff their opportunities?"

"Well," said Bill, "I'll tell you. I simply used that as an illustration, a kind of a parable, if you will. I might have used any one of a practically unlimited list, but that was the first one that occurred to me. Even at that it was not so far fetched as you seem pleased to imagine. Many a foundry owner has felt that he would be justified in committing murder after he has discovered that the star he has imported is only a lemon. Mind you the star may have been entitled to his reputation in his former position, but may have lacked the broad general experience that enables a man to adapt himself to an entirely different set of circumstances.

"So long as men are men—not the rip roaring, two-gun fire eaters who alternate between deeds of the most dangerous and violent character where the loss of a bucket of blood rarely incapacitates a man for more than a few hours, and love making scenes calculated to give any normal person the pip—I don't mean those kind of birds, but just plain men, even as you and I. In the event that you have lost track of the precious message let me repeat—so long as men are men, alibis and excuses will be provided by those who fail to deliver the goods.

"Investigators will conduct surveys and present voluminous reports that never are read by any person except the proof reader and what he reads goes in through his eye and out through his elbow. The survey and the report are based on the well known question: What is the matter with industry? The philanthropists draw conclusions tending to prove that the present deplorable condition is due to any one of a number of causes ranging from a high protective tariff and the selective immigration act, down to the havoc caused by the boll weevil in the solid South and the failure of the wild bull crop on the pampas of the Argentine.

"All piffle, me lad, to express the same idea in more refined language. English as she is spoke in her native land, it's all me bally old aunt Mariar.

"A certain number of trials and tribulations are the lot of every foundryman. This is a condition incident to the industry. It always has obtained and probably always will obtain now and forever, world without end. However, the principal cause of trouble in the foundry; vexation, heart burning and bitterness of spirit, is directly traceable to the fact that present day foundrymen do not receive a thorough training in the fundamentals of the art and science of founding in metals.

"The old time molder learned how to mix his own facing sand for green and dry sand molds, and core sand for small and large cores. He also learned how to daub the cupola, how to charge it, how to tap it out and how to drop the bottom. Every step in the process of making a casting was under his control and was reflected in the product. The lessons were not theoretical. Calloused hands, aching muscles and the gallons of bitter sweat that oozed from every pore and dried in the form of a saline deposit in the fabric of his shirt branded the lessons in his mind as irradicably as ever the broad arrow of the Queen was branded on the skin of unfortunate victims in the barbarous days of Botany Bay and Van Diemen's Land.

"The foundry business has been specialized to such an extent in recent years and the tendency is so pronounced toward still further specialization that men of broad general training capable of teaching others the trade in a manner that will fit them for supervisory positions, steadily are becoming scarcer. Another feature that is bound to exert an influence on the general situation is the fact that not all men are qualified to teach. They may have a comprehensive knowledge of the trade, but they lack the ability to impart that knowledge to others. I have heard a story one time which illustrates this point. It deals with the startling experience of a young man who took his bride for a short pleasure spin in a sail boat. If I were minded to adopt the methods of the regular reconteur I might claim that I figured personally in this adventure, but I never have held with that cheap form of piracy and besides all the king's horses and all the king's men could not force the Missus to go sailing in a contraption which she considers nothing more or less than a man trap.

"Our hero gallantly permitted the lady to handle the tiller while he crept forward to ease the jib. A sudden squall hit the main sail and instinctively the sailor yelled to his companion. 'Le' go the sheet, quick! LET IT GO!' The lady shot an indignant glance at him but did not move. Before he could stagger aft, a second puff hit the boat and over she went. Fortunately she floated and the young man dragged his companion onto the up turned bottom. Instead of expressing gratitude for saving her life she turned on him in a tantrum and accused him of causing the accident.

" 'Me?' he gasped. Me! Say, how do you get that way? Why didn't you let go the sheet when I told you to?

" 'Told you' she mimicked. 'Oh! yes, you told me all right. Why, you actually shouted at me and I want you to distinctly understand, you brute that I am not accustomed to being addressed in that manner!' "

Link Belt Co. Purchases Western Company

Link-Belt Co., Chicago, manufacturer of general elevating, conveying and power transmission machinery, cranes, gears, etc., has purchased the Meese & Gottfried Co., San Francisco, Los Angeles, Seattle and Portland. The Link-Belt Co. distributed its products formerly on the West coast through its subsidiaries, the Link-Belt Northwest Co., Seattle, and the Link-Belt Pacific Co., San Francisco. The Meese & Gottfried Co. is its predecessors have manufactured and distributed conveying and power transmission machinery on the coast for more than 40 years.

A new organization to be known as the Link-Belt Meese & Gottfried Co., with headquarters at San Francisco, has been formed to conduct the western business of the Link-Belt Co. and the business of the Meese & Gottfried Co. Charles Piez, president of the Link-Belt Co., Chicago, is chairman of the board of the new company, with B. A. Gayman president, Harold H. Clark, vice president and sales manager, Leslie W. Shirley, treasurer and Richard W. Yerkes, secretary.

Addressed Foundrymen

E. J. Lowry, metallurgist for Hickman, Williams & Co., Cincinnati, addressed the Detroit Foundrymen's association at the Tuller hotel, Oct. 18, on the blast furnace in relation to the foundry. He included a discussion of the quality of pig iron made in a blast furnace and its influence on the resulting product, touching also upon the influence of scrap in the production of pig iron and its resulting physical properties. In the discussion which followed, many points of interest to the members were brought out.

Cast Heavy Bronze Propeller

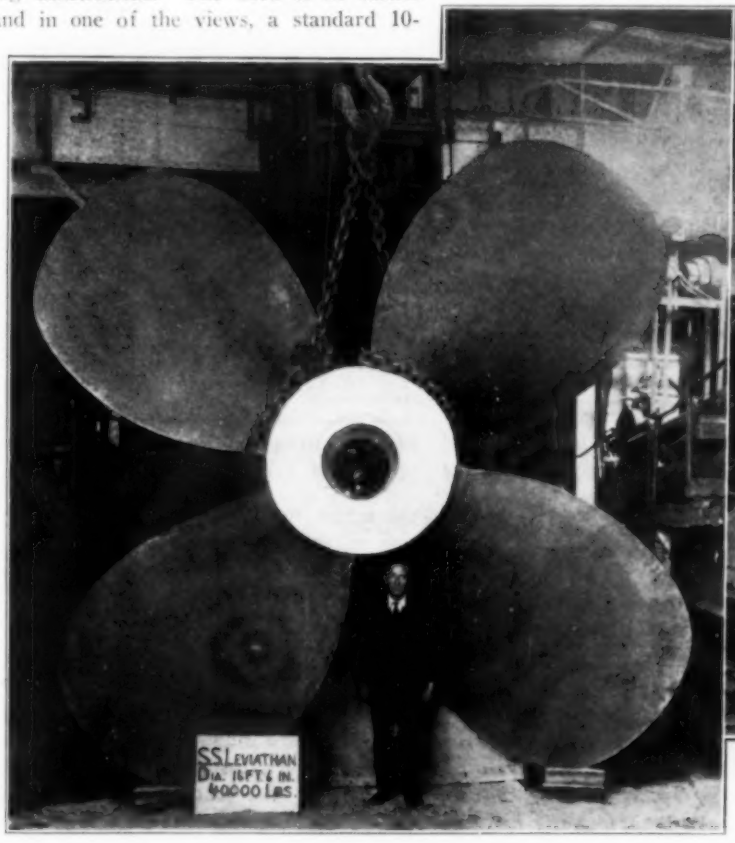
Exceptionally Large Propeller Cast in One Piece for Replacement Service on the Leviathan—Required Almost Thirty Tons of Bronze—Use Pattern for Single Blade

MANY records have been broken in the construction and refitting of the United States steamer LEVIATHAN and now comes the newest record, that of casting a spare bronze propeller calling for the pouring of 54,500 pounds of metal into a single mold. There are few plants in the country, probably few in the world, where such a heavy bronze casting could be turned out, and it may cause surprise to some to learn that one of these few plants is located in the little town of Bath, Me. The Hyde Windlass Co. has specialized on bronze work for many years and gradually has built up its facilities for turning out larger and larger work. Previous to the casting of the big LEVIATHAN spare propeller, this plant had turned out several propellers of as large or larger diameter, but nothing approaching it in weight. The LEVIATHAN propeller is 16 feet 6 inches in diameter and weighs approximately 40,000 pounds in its finished state and is believed to be the heaviest propeller ever made in this country. Some idea of the size of the casting may be gained from the accompanying illustrations. The bore is 20 inches and in one of the views, a standard 10-inch launch propeller is shown inside the bore. The foundry practice in connection with this huge propeller at all times was under the careful supervision of a representative of the American bureau of shipping. George W. Deane, superintendent of the Hyde Windlass Co.'s foundries was directly responsible for the molding an pouring. A wooden pattern for one blade of the propeller carefully was made up from blue prints, and after this was finished and approved, it was firmly mounted on a spindle free to swing 360 degrees and yet held at all times at the same angle with respect to the horizontal. One blade was molded at a time, the pattern being swung through exactly 90 degrees after each impression. Care was taken in setting the pattern each time to insure equal spacing and uniform pitch. The specifications gave small tolerance in the rough casting. In pouring the mold, test bars were precasted to determine quality of the molten metal and later test bars were cut from the casting itself and tested by the American bureau of shipping. Results in all cases were satisfactory. When lifted from the mold the surface of the large casting was as smooth as the surfaces of small launch propellers continually turned out at this plant. However, despite the smoothness of the casting, considerable time was required to finish the propeller as it had to be chipped and ground to a true pitch, and all the surfaces ground to a good finish. Finally, it was necessary to balance the blades of the propeller. The necessary rigging for the purpose of balancing the propeller is shown in Fig. 2.

J. C. McQuide has been made manager of the new Buffalo office, 622 Genesee building, recently opened by the Blaw-Knox Co., Pittsburgh.

M. F. Day Jr., representative for several months of Rogers, Brown & Co., has resigned.

The Pero Foundry Co., 23 Hermon street, Worcester, Mass., recently has been started after having been unproductive for a period.



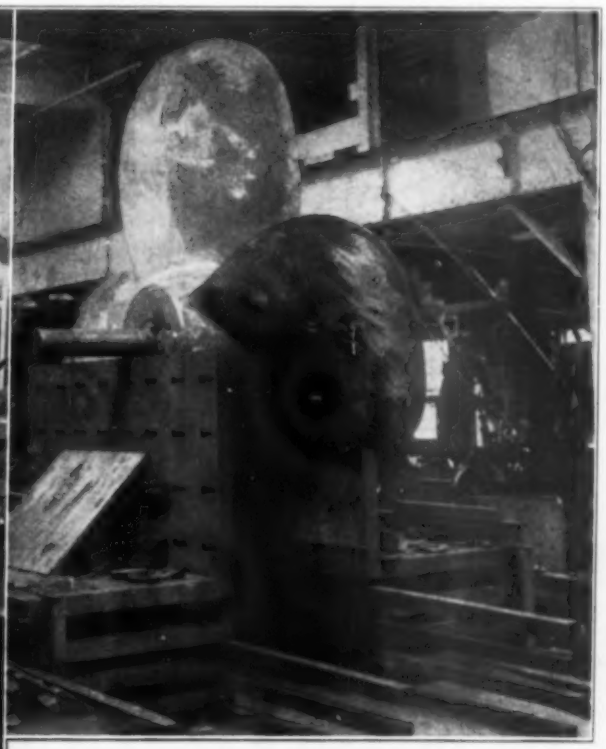


FIG. 1—OVER 54,000 POUNDS OF METAL WERE REQUIRED TO PRODUCE THIS CASTING. FIG. 2—THE FINISHED PROPELLER IS BALANCED SO THAT A SLIGHT TOUCH WOULD TURN IT OVER COMPLETELY

Buoy Ball Presents Problem

Perhaps the Most Interesting Feature of the Job Related to the Manner in Which Shrinkage Was Prevented by the Simple Expedient of Covering the Riser with Plumbago

BY LAWRENCE V. JOHNSTON

RECENTLY we completed an order for 20 spherical castings as shown in Fig. 1, with a diameter of 29 inches and weighing 3400 pounds each. The casting is designed to serve as a base and balance weight for a buoy, to maintain it in an upright position in the water. The heavy loop projecting from the bottom is formed in the blacksmith shop from a 2¼-inch diameter steel bar and is tucked into place in a suitable

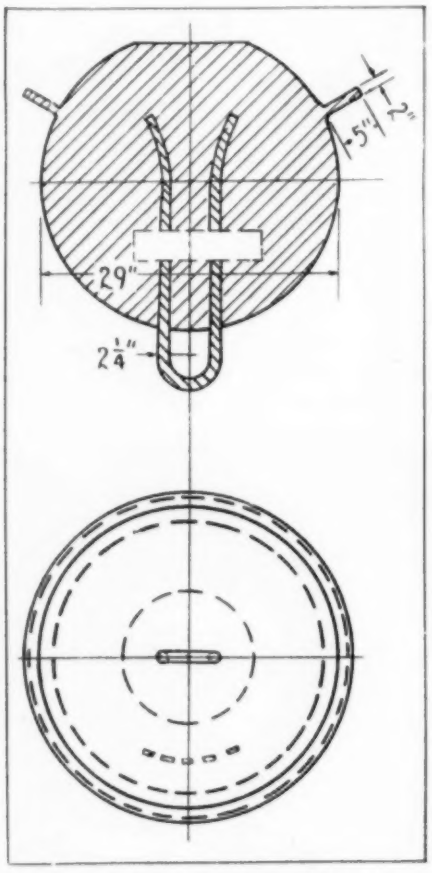


FIG. 1—SECTION AND PLAN OF CASTING

print before the mold is finished and blacked preparatory to drying. The inner ends of the loop are flared and nicked so that the molten iron may take a firm grip and prevent the loop from pulling out while the buoy is in service. The anchor chain is attached to the loop in the bottom of the ball and the manner in which a buoy strains at its mooring while tossed about in wild and stormy weather imposes a severe strain on the metal forming the pendant loop.

A flange 5 inches wide, 2 inches thick is cast integral with the casting about half way between the top and the center and serves as a foundation on which to rivet a corresponding flange on the bottom of the steel globe forming that part of the buoy which floats above the water. Five letters, initials of the words United States Light House Service, each 2½ inches long by ½ inch high, are cast on the lower part of the casting as indicated in Fig. 2. The letters establish the identity of a buoy if it breaks away from its anchorage and drifts into any of the numerous ocean currents. Then also represent one of the most rigidly observed of all government specifications which decrees that all national property shall be marked in a suitable and prominent manner.

Several methods were considered for pattern construction and also for molding the casting, but local conditions influenced the adoption of the pattern shown in Fig. 2. It will be noted that the pattern was split at a considerable height above the center line and immediately above the flange. The flange was attached firmly to the drag section of the pattern and that part of the pattern forming the bulge around the center was made separate in several sections and doweled on to the main body. While making the mold the body of the pattern was drawn first out of the drag. The loose pieces then were drawn in to the opening and lifted out. All the pieces except one were cut on radial lines on the ends. The ends of the odd piece were cut parallel to a center line as shown in the section on the extreme right in the sectional view Fig. 2. As a result of this arrangement the odd section served as a key piece and was drawn in first. With one section out of the way the others easily were removed.

Pattern Construction

The principal reason for making the pattern in the manner shown where it is nearly all molded in the drag was to take advantage of a jolt machine in ramming the sand. The comparatively shallow cope was rammed by hand. In this way one plain rollover board served instead of two special follow boards which would have been required had the pattern been split in the apparently logical manner along a center line and with the flange doweled in place on the cope half of the pattern, or even if it had been split immediately under the flange.

The loose top might have been attached firmly to the remainder of the pattern without adversely affecting the molding or lifting features, but that type of construction would have necessitated a deep follow board with an opening in

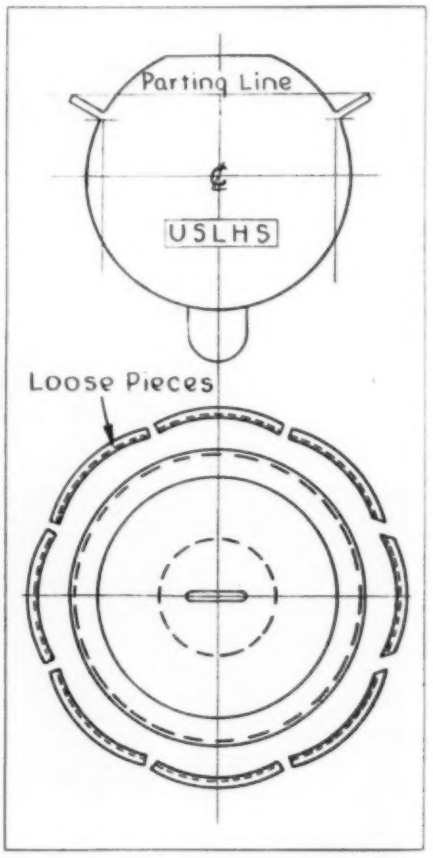


FIG. 2—SHOWING HOW PATTERN WAS PARTED

the center to accommodate the cope section of the pattern and it was felt that a jolt machine works most efficiently when the flask is brought close to the jolting table.

In the method adopted the flat joint surface of the pattern and also the edge of the flange rested firmly on a plain rollover board and thus prevented any undue pressure, distortion or shifting on the part of the pattern while the sand was being rammed in the drag. The

sections forming the loose belt around the center of the pattern were dowelled in place and as an added precaution to prevent them from shifting they were fitted against a shoulder on the main body of the pattern.

Large blocks letters *U S L H S* might have been attached to one of the loose pattern sections and drawn in with it, but a more convenient method was adopted whereby the letters were formed in a dry sand core and rammed up with the pattern. The letters were blacked and finished in a more satisfactory manner by this method and as a result presented cleaner and sharper outlines on the casting. A rectangular area painted on one side of the pattern served as a guide in locating the letter core. The position was not arbitrary and so long as the letters appeared on the casting in that general vicinity, they were considered satisfactory. The casting was molded in 42-inch square flask made up of seven sections each 6 inches deep Five sections formed the drag and two sections bolted together served for a cope. The sections were planed on the joints and provided with three pin holes, two on one side and one on the other. The holes were all drilled through a jig and therefore the flask sections were interchangeable. The flask sections were flanged top and bottom to facilitate clamping the assembled mold together. The flask was not placed directly on the rollover board, but was supported on 2-inch wood strips and in this manner the joint face of the drag was brought flush with the lower edge of the pattern flange. A long horn gate made from a piece of brass pipe ¾-inch diameter was rammed in one corner of the flask. One end rested on the follow board and the other end rested on the pattern near the bottom, but in such a manner that the stream of iron would not strike directly on the projecting ends of the steel loop.

The pattern was covered with facing sand and the flask was filled with heap sand to the top of the pattern. The mold then was jolted and a space scraped away for the reception of the letter core. After the core was set the remainder of the flask was filled with sand and jolted until in the opinion of the operator the sand had assumed a sufficient density to resist the pressure of the molten iron. A bottom plate was clamped in place and the drag was rolled over and made ready for the cope which was rammed directly on top of the drag. The upright runner in the cope was placed a few inches away from the runner in the drag and a connecting channel was cut in the sand of the joint. This arrangement served to break the fall of the iron and introduced it into the mold more gently than if it had been poured straight down in one unbroken stream.

After the pattern was removed from the mold it was placed back on the rollover board, a second flask was lowered into place and the helper proceeded with the job while the molder was tucking the loop in place in the first mold, blacking the cope and drag and loading the two parts of the mold on the oven car. The molder and helper easily made two molds a day with the help of the molding machine which not only rammed the sand much more quickly than it could have been rammed by hand, but also rammed it more uniformly. To insure a clean skin on the casting, the mold was black washed a second time after the mold was removed from the oven and while it still was hot enough to dry the blacking. The small gate, through retarding the flow of the metal, helped to cool it off considerably and this, also, was a factor in securing a clean, smooth skin on the casting. Several articles have been published within the past year dealing with the subject of pouring castings through small gates and providing no risers. The practice apparently has been successful in many instances but experience gained in casting the particular job under discussion would seem to indicate that it is not applicable in all cases. In all, six castings were poured before a satisfactory method was discovered to prevent shrinkage. Taking them in order they were made as follows:

No. 1. A number of old crabs sandblasted until they were thoroughly cleaned, were placed in the mold for the purpose of cooling the iron. After the mold was filled with molten iron the molder fed it through an 8 x 6-inch riser until the metal in the riser solidified. Fresh iron was added from time to time and every effort was made to keep the riser open as long as possible. However it finally closed while the metal in the interior of the casting still was in a molten condition and as a result when the riser was knocked off on the following day a large shrink hole was disclosed.

No. 2. Larger pieces of cold iron were placed in this mold and the iron was fed through the riser as in the first instance. The result was the same with the exception that the shrinkage cavity was not so extensive.

No. 3. A still greater quantity of old iron was placed in this mold and the experiment was tried of casting it without a riser. A sunken area around the top of the casting was the result.

No. 4. This casting was tried without any cold iron in the center or with-

out any riser on the top. It was the most unsatisfactory of the lot. A thin shell of iron formed against the cope but the remainder of the iron receded. The shell was so thin that it would not support the weight of the casting when the casting was shaken out.

No. 5. This casting was equipped with a riser which was fed for a while after the mold was poured. When the riser showed signs of closing, a piece of clean pig iron was forced down through the riser and into the casting. It was confidently expected that this treatment would produce a solid body, at least at the point where the riser joined the casting. Even if a hollow developed in the interior of the casting it would not affect either its usefulness or its appearance. The expectation was not realized. When the riser was broken off the pig iron was plainly discernible and in addition a shrink hole appeared alongside.

Secures Solid Casting

No. 6. Acting on the theory that it was useless to try to prevent the casting from developing a shrink hole, no scrap iron was placed in the mold and no attempt was made to feed the casting through the riser. The top of the riser was covered with a shovel full of plumbago and no further attention was paid to it. When the riser later was knocked of the casting it showed a solid fracture.

After considering the matter carefully and bearing in mind the result of the former experiments it would seem that the riser kept feeding the casting until the shell had set. After the shell began to contract on the still liquid metal in the interior, some of this metal was forced up into the shrink hole that undoubtedly had formed under the riser. This theory is borne out by the appearance of the fractured end of the riser which presents a cold shut appearance as if the metal that was forced up from the inside did not knit properly with the remainder. The remaining castings were adjusted and poured in the same manner.

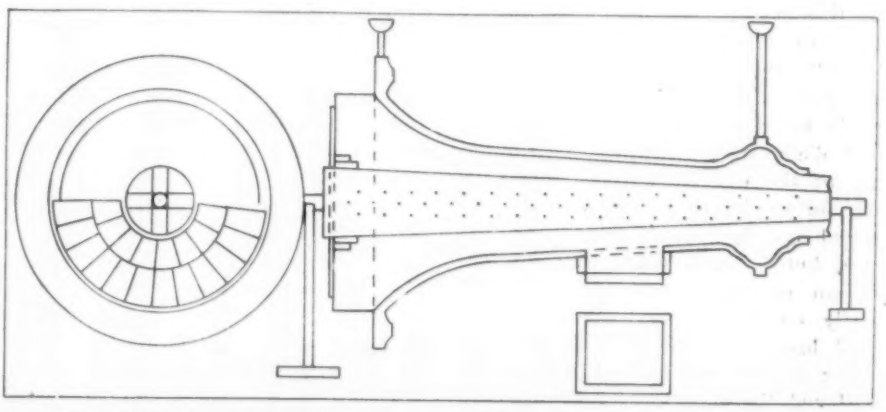
MakesLoamPatternforLampStandard

BY THOMAS NELSON

SIX castings similar to that shown in the accompanying illustration were ordered at one time, and to save patternmaking expense we decided to make what is known as a *boss*, that is to run it up on a core barrel and make the flanges and other attachments of wood. The casting was 5 feet in diameter across the wide end, 9 feet long and tapered down to 12 inches diameter at the narrow end, with an average metal thickness of 1 inch. Several cast-iron core barrels were available and two were pressed into service, one for the pattern and one for the core. Of course, we had to use considerably more rope and loam than is customary under ordinary circumstances. A cast-iron grid 4 feet in diameter was wedged firmly on the large end of the barrel to serve as reinforcement on the end of the core. The usual practice was followed in sweeping the pattern and core, with the single exception that the pattern was coated with tar to preserve a hard surface. The loam board employed conformed to the required contour of the pattern except for a shoulder at the high end. This shoulder or recess on the core served as a seat, or guide, for locating and holding in position the flange, made in 8 sections. In addition to the seat, 6-inch spikes driven through the flange segments into the base, were employed to hold the flange in true alignment during the molding process. A boss with 1¼-inch core print was attached to each section of flange. The slight jog where the flange runs into the curved face was slicked down while finishing the mold.

In making the mold the pattern was bedded in the floor, with the 2-inch spindle at either end resting on suitable cast-iron stools, shown. The notches on top of these stools, later served to guide the core into its proper place. The cope was rammed in two sections, divided about the center. It was blackwashed and dried in the core oven. The drag half of the mold was dried by suspending several coke fire buckets inside and covering the mold. The mold was poured through four small pop gates on top near the center, and carried a riser on the highest point at each end.

A point sometimes overlooked in sweeping molds or cores of this character, that is, where the ends project beyond the straight section, is that when the loam board is advanced, or drawn toward or away from the main body of the core, the clearance at the ends does not equal that on the straight face. In extreme instances, where the ends are at right angles to the spindle there will be no clearance. For that reason it is advisable to attach loose pieces at those points on the loam board while roughing up the core and remove them before applying the finishing coat of slurry.



A CAST-IRON GRID AT THE LARGE END HELPED TO REINFORCE THE HEAVY BODY OF ROPE AND LOAM BUILT ON THE CENTRAL BARREL

Interest Features Heat Treater's Convention

All previous attendance records were broken at the fifth annual convention and exposition of the American Society for Steel Treating held in Pittsburgh, Oct. 8-12. Registration totaled approximately 1800 of which nearly 1500 were classified as members of the society. Technical sessions each morning were held at the William Penn hotel, while the afternoon sessions were conducted at Motor Square Garden where the steel exposition was in progress. This year's exhibition was larger by one-third than any previous show and included a larger and more complete range of heat treating equipment and products. Practically

all of the electric, gas and oil furnaces were in operation as were the sand-blast, welding and machine tool exhibits.

Several papers presented at the technical sessions were of interest to foundrymen. In a paper, "Metallography and Testing of Oxyacetylene Welds," by J. R. Dawson, research metallurgist, Union Carbide & Carbon Research Laboratories, Inc., Long Island City, N. Y., the author emphasized the necessity for employing trained welders with competent supervisors. He also said it was important to use a good grade of welding wire. Advantages of welding cast iron were given as: (1) The joint obtained is of high quality; (2) the weld and adjoining metal are machinable; and (3) the welding repair, in addition to costing much less than a new casting, usually is important because of the time saved.

"Case Hardening and Other Heat Treatments as Applied to Gray Cast Iron," by H. B. Knowlton, instructor, Central Continuation school, Milwaukee, was an interesting paper presented on Tuesday morning. Apparently little work has been done on this subject. An investigation was suggested by a manufacturer who has been case hardening castings commercially for some time with success obtaining an increase of 50 per cent in the casting life. However, upon changing the source of supply of the castings, the work failed completely. Theoretically, the high silicon content of the casting precludes the absorption of more carbon and castings packed in a carburizing compound and heated showed little increase in carbon content. On the other hand, packing in the compound did prevent oxidation and caused a retention of the original carbon. Long heating gave an increase in the combined carbon on the outside of the casting. The author did not care to speak of the action as a case hardening action. Briefly what was desired was a malleablizing process with a case hardening effect all in one operation.

Vincent T. Malcolm, metallurgist, Chapman Valve Co., Indian Orchard, Mass., read a paper, "Physical Properties of Metals at Elevated Temperatures", Davis metal, monel metal, bronze and cast steel being the chief metals investigated. Both Davis metal and monel were found to function satisfactorily in the field at elevated temperatures. Lead was used to replace copper in Davis metal with results not satisfactory. Bronze was found to be treacherous above 400 degrees Fahr., while cast steel stood up well.

In an effort to determine the aging or seasoning effect on steel castings and forgings, W. P. Wood, department of metallurgy, University of Michigan, Ann Arbor, Mich., is conducting an investigation using a number of types of steels. Although the tests have not reached a point to which definite conclusions can be drawn, the progress made thus far was reported in a paper, "The Seasoning of Steel", presented by Mr. Wood. He showed that though no obvious reason can be given for aging or seasoning, the tentative results show that appreciably higher ductility is obtained on steel that has been aged. Test samples of the various steels were made up and tested immediately for tensile strength, elongation and reduction of area, while samples of the same steels were allowed to age for one year. Tests made at the end of the year showed practically no change in the tensile strength, but did show greater elongation and reduction of area. In discussion it was brought out that in conducting further tests it would be desirable to determine also relative elastic limits and ultimate strengths.

Adopts Melting Units to Meet Varied Needs

(*Concluded from Page* 872)

the entire bay. Two swing grinders, and six portable pneumatic grinders, facilitate grinding the larger castings. The larger of the swing grinders is shown in Fig. 6. This is driven by a 7½-horsepower motor and the smaller by a 5-horsepower motor.

The smaller castings are snagged in a shop, 70 x 80 feet, a portion of which is shown in Fig. 7. Two of the six tumbling barrels installed in this department appear in the background. Beyond these and to the left is the storeroom, which is 50 x 80 feet. In the background is one of the entrances to the main offices, which extend along the front of the right wing. The laboratory where preliminary and final analyses of all heats are made, is located in a room between the main offices and the storeroom.

The grinding shop is equipped with six double-stand grinders, operated by a line shaft, and one double-stand grinder direct connected to a motor. They are provided with emery wheels. A surface speed of 5500 feet is maintained as nearly as possible on all machines, those on the line shaft being provided with a differential belting system. The wheels, for the most part, are bought in sizes of 20 and 24 inches diameter, and as they are worn down by successive stages of two inches or so at a time they are transferred from one machine to another. When reduced to about eight inches in diameter, they are placed on the air grinders where they are worn down to six inches and then discarded. As many of the wheels have an arbor hole of 2½ inches, it is often necessary to bush them up by successive stages as the wheels are reduced and placed on the various machines.

The larger of the two swing grinders, previously mentioned as located in the chipping shop, and the direct motor-driven stand grinder are equipped with wheels 24 inches in diameter. The former machine takes an arbor hole of 2½ inches, while the latter takes a bore of 2 inches. A wheel of 20 inches is the largest used in the shaft-driven stand grinders, all of which take a bore of 1½ inches.

Virtually all the wheels, which are of the taper type, have a width at the outside circumference of 2 inches. However, an exception is noted in the wheel used on the smaller swing grinder, which has a width of 1½ inches. The circumference of the wheel used on this machine is 18 inches.

Subsequent to grinding, the smaller castings are placed in the tumbling barrels. Four of these are round, 2½ feet in diameter and 5 feet long, and two rectangular, 3 feet 4 inches square and 6 feet 6 inches long.

The larger castings are annealed in an oil-fired furnace, 9 x 12 feet, located in a leanto, corresponding in position and similar in size to the sand blast room, at the opposite end of the open hearth foundry. They are annealed at a temperature of 1600 to 1700 degrees Fahr., the length of time in which they remain in the oven depending upon the character of the castings. Two motor generator sets also are installed in this leanto, one for the cranes and the other for the welding equipment. The larger castings are welded by the carbon arc process, and the smaller by the metallic electrode method.

The smaller castings are annealed in a 16-foot furnace, installed in the grinding room in the right wing. The castings are fed into the oven on cars which run level with the floor, in a pit extending a suitable distance on either end of the furnace, a system which provides for the continuous operation of the furnace.

The shipping department is in the rear of the right wing. It is provided with two sets of scales and a 5-ton electric overhead crane with 38-foot span, to facilitate loading. A well-equipped machine shop, 40 x 40 feet, occupies one corner of the wing.

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Evolution of the Steel Casting

PRODUCTION of steel castings on a commercial basis, at a moderate cost per pound to the consumer and yet a cost that yields a more or less liberal margin of profit to the producer is regarded in modern industrial circles as nothing out of the ordinary nor worthy of special comment. Castings are made in green sand molds, dry sand molds and molds that are skin dried. The metal is melted in electric furnaces, bessemer converters, acid and basic lined open-hearth furnaces fired with natural or producer gas, with oil, and in some cases supplemented with tar introduced through various types of burners in the ports. In many cases a local sand is employed and beyond a brief period of preparation in a muller type of sand mixer, no special attention is paid to the sand. Old sand is used in large amounts for facing and steel for large quantities of small castings is shanked in hand ladles after the manner prevalent in gray iron foundries.

Foundrymen whose active participation in steel casting production extends back over a period of less than 30 years cannot but marvel at the manner in which methods and processes incidental to the industry have changed for the better in that time. Early experiments conducted with a view to casting a metal which hitherto always had been manipulated under the hammer or through the rolls, were fraught with trouble, danger, expense and the usual discouraging features that confront pioneers who seek to blaze a path through a new and unexplored territory. Not so many years ago blowholes were accepted as an inevitable feature of steel castings and men yet active in the industry can remember when a phrase was current among iron foundrymen to the effect that a steel casting was nothing but a collection of holes held together by a more or less irregular network of steel.

The most profound secrecy and mystery enshrouded the few plants engaged in the early production of steel castings. Each foundry worked out its own salvation, slowly, painfully and with many a bump while going over the rough spots. This accounts in great measure for the comparatively slow progress made in the early stages of the business.

All the secrets appertaining to steel castings, particularly those that lie in the field of supplementary heat treating have not yet been discovered, but the steel foundryman is justified in feeling a legitimate pride in the reflection that he has traveled farther on the road to perfection and in a shorter time than foundrymen engaged in the production of castings in many other metals. Steel castings produced in the United States in 1900 amounted to approximately 250,000 tons, in 1905 this had increased to 500,000 tons, by 1920 the production had grown to 1,000,000 tons and an estimate of the current year's production places it at 1,500,000 tons. All of which would seem to bear out the contention that the expansion of the steel casting industry in the United States within the memory of living man presents the most outstanding example of metallurgical, mechanical and commercial progress in the history of this or any century that has gone before.

Trade Outlook in the Foundry Industry

SLIGHT tendencies to taper off are noted in castings orders. Jobbing foundries making gray iron castings, malleable shops and steel jobbing foundries were not so active during October as in September. However, continued demand and a stable backlog of orders have supported operations in stove and furnace, cast iron pipe and sanitary ware foundries. Improvement is noted in the demand for machine tool castings, based upon increased sales of machinery to railroad and automobile shops. The latter are making replacements and although delivery of finished tools may be deferred until the first of the year, castings orders are being placed.

Accumulate No Stocks

No effort is apparent to build up reserves in any line of manufacture. Castings are ordered on a hand-to-mouth basis, and foundries are buying equipment and raw materials only as needed for immediate use. The tendency is evident in all lines to keep down inventories toward the close of the year. In fact, some orders are placed or inquiries made with a distinct understanding that delivery is to be made after Jan. 1. The general effect of this careful avoidance of forward buying has been to lessen the total volume of business coming to foundries. Castings are produced only as needed for immediate service, but with the general state of business in all lines, the exceptional movement of commodities as indicated by car loading figures, and other indications of industrial activity, it is evident that consumption is not slackened and that buying is only deferred. The fact that stocks are pared to the bone and that inventories in manufacturing lines are reduced to the point where another dollar's worth could not be removed without affecting present operations, promises that improvement in castings demand may be expected.

Prices of Raw Material for Foundry Use

CORRECTED TO OCT. 26

Iron		Scrap	
No. 2 Foundry, valley	$22.50 to 23.00	Heavy melting steel, valley	$16.50
No. 2 Southern, Birmingham	20.00 to 21.00	Heavy melting steel, Pitts.	15.50 to 16.00
No. 2 Foundry, Chicago	25.00	Heavy melting steel, Chicago	13.50 to 14.00
No. 2 Foundry, Philadelphia	23.76	Stove plate, Chicago	17.50 to 18.00
No. 2 Foundry, Buffalo	22.00 to 22.50	No. 1 cast, Chicago	20.50 to 21.00
Basic, valley	24.00	No. 1 cast, Philadelphia	19.00 to 20.00
Basic, Buffalo	23.00	No. 1 cast, Birmingham	19.00 to 20.00
Malleable, Chicago	25.00	No. 1 cast, Buffalo	19.50 to 20.50
Malleable, Buffalo	22.00 to 22.50	Car wheels, iron, Pittsburgh	16.00 to 16.50
Coke		Car wheels, iron, Chicago	18.00 to 18.50
Connellsville foundry, coke	$5.00 to 5.75	Railroad malleable, Chicago	19.00 to 19.50
Wise county foundry, coke	5.75 to 6.25	Agricultural mal., Chicago	19.00 to 19.50
		Malleable, Buffalo	17.00 to 18.00

Auto Output Large

Automobile production runs counter to all expectations. The buying which normally declines in October, has shown decided strength. Dealers are not overstocked with cars. Some manufacturers have reduced their schedule of operations, while others have increased. The September production of all classes of automobiles, according to the department of commerce reached a total of 327,365 vehicles. Of this total, the output of 298,910 passenger cars was the largest ever reported for the month of September and exceeded the July, 1923 production by 1580. The total number of automobiles built during the first nine months of 1923 was 3,084,000, or 16 per cent in excess of the total for the entire year in 1922. Apparently October will show only a slight recession from the September total production, and the year's record will approach 4,000,000 automobiles of all classes. The saturation point, predicted as at hand from year to year, is a receding variable. At present, it is stated that 13,000,000 automobiles are registered throughout the country. This closely approaches two-thirds of the number of families and probably exceeds the number of dwellings.

Steel Shows Loss

Bookings of steel castings, as shown by the department of commerce, dropped from 50,515 in August to 47,574 tons in September, with 65 identical companies reporting. The September orders represented 49.1 per cent of capacity. Railway castings orders increased from 47.9 per cent of capacity for August to 56.6 per cent in September, while a loss of almost 10 per cent is shown in comparing the figures for miscellaneous castings as reported in the two months named. Malleable foundry operations in September were about 56 per cent of capacity, compared to 60 or 65 per cent in August. Railways again are buying, and inquiries indicate continued demand for castings from this source for the remainder of the year. Car and locomotive inquiries alike are increasing. September shipments of locomotives totaled 335, leaving 1178 unfilled orders at the end of the month, compared with 1497 for August. Cast iron pipe foundries continue to operate at capacity, but a slight recession is noted in the demand for soil pipe and fittings. Stove foundries are active, those in the eastern section, in Michigan, Ohio and Indiana working at capacity and in the St. Louis district at from 80 per cent to full time. Building construction again is a factor in castings demand, with an increase in orders for building hardware, plumbing goods and sanitary ware. Sales of washers, sweepers and other domestic appliances which have grown to be important as factors in the castings market, are increasing. Employment statistics indicate only a slight decline in the iron and steel, foundry and machine lines.

Nonferrous Prices

Prices for nonferrous metals based on New York quotations in the *Daily Metal Trade* of Oct. 26, follow: Casting copper, 12.25c; electrolytic copper, 12.50c to 12.62½c; Straits tin, 42.37½c; lead, 6.85c to 6.90c; antimony, 8.25c; electrolytic nickel, 32.00c; aluminum, No. 12 alloy, open market, 20.00c to 21.00c. Zinc is 6.30c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

JOHN D. BABBITT, who for 21 years was connected with the Joseph Reid Gas Engine Co., Oil City, Pa., and Robert R. Dempsey for 12 years with the Butler Engine & Foundry Co., Butler, Pa., have purchased the plant of the Johnsonburg Machine Co., Johnsonburg, Pa. A general line of jobbing castings in gray iron, brass, and bronze will be made and a machine shop will be conducted for handling repair work.

Christian W. Lynch has been named receiver for the Harrisburg Foundry & Machine Co., Harrisburg, Pa.

Fred Bennett, Buckeye Steel Castings Co., has been elected secretary of the metals section of the National Safety Council.

Zay Jeffries, research engineer, Aluminum Co. of America, Cleveland, has been elected treasurer of the American Society for Steel Treating.

E. E. Hall has been elected general superintendent of the Biddeford, Me., division of the Saco-Lowell Shops, Boston. He has had considerable experience in western foundries.

H. A. Frommelt, Falk Corp., Milwaukee, will address the Quad City Foundrymen's association at its meeting in November on the subject of apprentice training.

Frank Cotington has recently been appointed superintendent of the foundry department at the Holyoke Machine Co., Worcester, Mass. Mr. Cotington was formerly with the Wm. Cramp & Sons Co., Philadelphia.

J. George Lehman, Bethlehem Foundry & Machine Co., Bethlehem, Pa., and Peirce D. Schenck, Duriron Co., Dayton, O. have been elected vice presidents of the Chemical Equipment association.

G. J. Garrard, formerly superintendent of the plant of the Northwestern Malleable Iron Co., Milwaukee, has been appointed manager of the Jamestown Malleable Products Corp., Jamestown, N. Y.

John R. Lee, formerly vice president of the Wills-St. Claire Automobile Co., is in charge of the plant recently opened in Walkerville, Ont., by Dodge Bros., Detroit, motor car manufacturer.

William J. Watkins, recently appointed superintendent of the steel foundry of the Lorain Steel Co., Johnstown, Pa., succeeding G. W. Merrefield, resigned, has been an employe of that company since 1889.

Robert T. Barnett recently has been made superintendent for the Florida Machine Works, Jacksonville, Fla. This company is erecting a new plant which will include gray iron and steel foundries and a machine shop.

J. F. Gaffney, who for the last three and one half years was superintendent of the Bethlehem Steel Co.'s foundry at Sparrows Point, Md., has resigned. Mr. Gaffney contemplates a month's vacation before taking up other work.

Dave Ward, general manager, Federal Furnace Co., Chicago, addressed a meeting of the Quad City Foundrymen's association at Davenport, Ia., Oct. 15 on the making and melting of pig iron. In the discussion which followed, George Long, Pickands-Brown & Co., Chicago, answered questions of the foundrymen present on technical problems.

Charles N. Giren recently has been placed in charge of the No. 1 foundry of the Warren Foundry & Machine Co., Phillipsburg, N. J. Mr. Giren formerly was connected with the Valley Mold & Iron Co., Black Lick, Pa., and previous to that time was connected with the Peerless Foundry Co., Latrobe, Pa., and the Westinghouse Electric & Mfg. Co., Trafford City, Pa. Mr. Giren served as a molder for 15 years with the Kelly & Jones Co., Greensburg, Pa.

Harold E. McIntyre recently has joined the staff of the Western Foundry Co., 36th street and Kedzie avenue, Chicago. Mr. McIntyre was employed from 1901 to 1916 by the Fairbanks, Morse Co., Beloit, Wis. During the following two years he was general foreman for the J. I. Case Threshing Machine Co., Racine, Wis., after which he went to the Sawyer Massey Co., Hamilton, Ontario. For the past two years Mr. McIntyre has been general foreman in the gray iron foundry at the Saginaw Products Co., Saginaw, Mich.

Appointed Treasurer

Richard W. Yerkes, formerly general manager of the Link-Belt Co., Philadelphia plant, has been appointed treasurer of the Link-Belt Company, succeeding B. A. Gayman. Mr. Gayman was selected by Charles Piez, president of the Link-Belt Company, to head the newly acquired Meese & Gottfried Co. of San Francisco. The new company will operate under the name Link-Belt Meese & Gottfried Co., San Francisco. Mr. Yerkes will be located at the Link-Belt Company's general offices at 910 South Michigan avenue, Chicago.

Reorganize Shop

The Valley Foundry Co. organized at East Hampton, Conn., in 1920 has been reorganized and is now under the control of the Connecticut Foundry Co., Rocky Hill, Conn. This makes the controlling company one of the largest jobbing foundries in New England. The president of the Valley Foundry Co. is A. O. Knudson.

Ohio Foundrymen Will Meet in Toledo

In addition to the regular members it is expected that many prominent foundrymen from the neighboring states of Michigan and Indiana will attend the fall convention and third annual meeting of the Ohio State Foundrymen's association to be held in Toledo, O., Nov. 15 and 16. The Waldorf hotel at the corner of Summit and Madison avenue, conveniently located in relation to the various railroad stations, will serve as headquarters during the convention. The business sessions, luncheon and informal banquet will be held at the Toledo Yacht club.

At the opening session Thursday Dan M. Avey, managing editor THE FOUNDRY, will deliver an address, "Patterns, the Starting Point of Profit and Loss." This will be followed by "Insurance Contracts and the Adjustment of Losses" by W. M. Todd, district manager Western Adjustment Co., Toledo. "Problems in Brass Foundry Practice and Their Solution" will be considered by Fred L. Wolf, technical superintendent Ohio Brass Co., Mansfield, O. E. T. Runge, E. T. Runge Cost Co., Cleveland, will discuss "Foundry Costs, Ferrous and Nonferrous." The remainder of the afternoon will be devoted to a reception of the reports of committees on costs,

labor training, nomination and resolutions.

On Friday morning Toledo members will act as host to the visiting members on inspection trips to the plants of the Willys-Overland Co., and the Toledo Furnace Co. The general committee is made up of C. C. Smith, Toledo Steel Casting Co., C. E. Bunting, Bunting Brass & Bronze Co., Wm. Baker, Baker Bros. R. R. Simonton, Ensign Foundry Co., is taking care of transportation features and C. F. Carson, National Supply Co., is chairman of the reception committee. Frank W. Huber, Armco Iron Co., Middletown, O., is president of the association; Walter L. Seelbach, Walworth Run Foundry Co., Cleveland, is treasurer and A. J. Tuscany, Century building, Cleveland, is secretary-manager.

Malleable Association Engages Expert

It is understood that the association of manufacturers of malleable iron castings in France, Belgium, and Luxembourg, which was formed at the international foundrymen's congress in Paris in September, will be known tentatively as The Franco-Belgian Malleable Castings association. Marcel Remy, a malleable foundry proprietor of Herstal, near Liege, Belgium, is one of the principal factors in the new organizations of which at present about a dozen companies are members. The new society has engaged the services of Prof. Albert Portevin of Paris as technical expert, and it is the intention of the society to proceed with its work along the lines of the American Malleable Castings association.

Ford Company Starts Foundry Addition

The Ford Motor Co., Detroit, has started construction on an extension to its present foundry facilities at the River Rouge plant. The new foundry will be 400 x 600 feet and will be equipped in a manner similar to the continuous foundry now in operation at River Rouge.

Book Review

Fundamentals of Welding, by James W. Owens, 660 pages, cloth, 6 x 9; published by The Penton Publishing Co., Cleveland, and supplied by THE FOUNDRY, Cleveland, price $10.00.

Although fusion welding is the theme of this book, it actually includes by reference or description every manner or method of joining metals known to science or industry, including mechanical joining, welding, and soldering with all their posible ramifications. However, because the possibilities of fusion welding in industrial applications are so numerous, the author centers the principal discussion about the fundamentals of these forms, namely gas, arc and thermit welds, the three main classifications of the fusion type of welding.

The chapters dealing with the choices of methods, designs, speed and cost of welding and cutting, production and distribution of oxygen, hydrogen and acetylene, welding rods, electrodes and fluxes, protectors and safety precautions, organization, shop and school layouts, training, and practical applications satisfy the requirements of a book of this nature, supplementing theory with practical applications. The theoretical phases of gas, arc and thermit welds are discussed in separate chapters, and the subject of arc welding generators, transformers, and wiring systems is made vivid by numerous illustrations and diagrams.

One chapter is devoted to a study of the microstructure of fusion welds, and the text is accompanied by micrographs which indicate the latest developments in the knowledge of weld structure, annealing effects and similar topics. Another subject of equal importance is the study of residual stresses and their remedies, the lack of which has obstructed progress in some applications of welding.

Another objection to the use of welds in the past has been the want of satisfactory methods of testing without actually destroying the weld by a series of strain examinations. Realizing that the future of welding depends upon the removal of this difficulty, the author has suggested reliable tests for each step in the progress of the weld, including tests for the material, ingot, billet, wire, welding rod and electrodes, base metal, weld deposited metal, joint, and finally the completed joint. The proposed tests described for the latter include the strain gage, X-ray, magnetic, electrical conductivity and sound examinations. Practical tests now in use for determining the strength of the joint are discussed and their advantages and disadvantages pointed out. A chapter on recent investigations and the conclusions derived therefrom precedes the index.

As a text of the fundamentals of gas, arc and thermit welding this book is extremely valuable. In solving practical welding problems in the repair of machinery and castings of all descriptions it furnishes a valuable aid. Inasmuch as welding is recognized as a satisfactory method of putting metals together and its use is growing, an encyclopedia of this nature is important from an industrial and scientific standpoint.

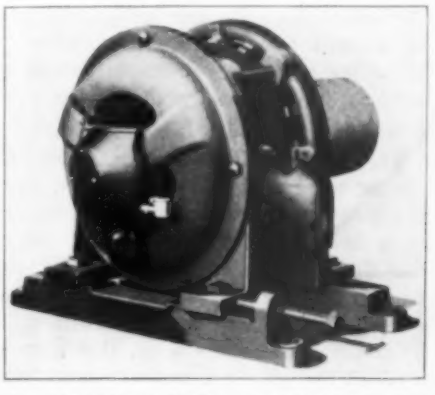
The author in this book and in his previous researches regards welding as a science rather than an art. For this he is particularly qualified because of his extensive investigations conducted at the navy yard at Norfolk, Va. In these experiments he has had an opportunity to execute extensive welding projects, and the liberal use of welding in the construction of new navy vessels is due in considerable measure to his pioneering investigations and practical advice.

Pipe Exports Reduced

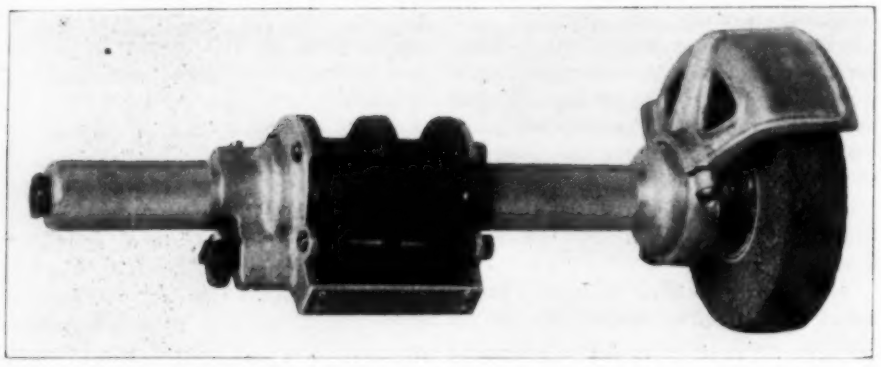
Statistics for the first half of 1923 indicate that the exports of cast iron pipe increased 37 per cent over the general average in May and that in June the quantity had decreased 19 per cent below the general average. The malleable iron pipe fitting tonnage in the same period had the same experience, increasing 12 per cent above the normal in May and falling 9 per cent below in June. Inasmuch as the half years tonnage of cast iron pipe was four times as great as the malleable iron pipe tonnage, the relative difference in the two markets is probably due to the fact that the cast iron market was more affected by the falling off of the heavier buyers than in a lighter market where confidence and psychology do not play as big a part.

Introduce New Type of Induction Motor

The Reliance Electric & Engineering Co., Cleveland recently has introduced a new type of induction motor for particular use in various installations in automobile, textile, wood-working, machine tool plants, foundries, etc.



INDUCTION MOTOR ADAPTABLE TO FOUNDRIES AND MACHINE TOOL PLANTS



THE MOTORS ARE SET OPPOSITE IN TANDEM ON THE DRIVING SHAFT, THUS INSURING A PERFECT BALANCE

Among the features of this motor, a view of which is shown in the accompanying illustration, are included the insulation of the stator windings, bearings, motor construction and the high overload torque capacity.

The frames of this type of motor in sizes up to 25 horsepower, 1800 revolutions per minute are of riveted construction. The stator punchings, of special electrical sheets, are assembled with flanges under a 10-ton pressure. Large rivets are inserted, the ends electrically heated and then upset. The end flanges are ribbed to give greater support to the stator laminations. The feet which are cast integral with the flanges are thick and solid. The slots in the stator punchings are semienclosed with a ⅛-inch opening at the top of the slot. The liberal opening makes winding easy and at the same time increases the overload torque capacity of the motor.

Produces a Monoxidizing Soldering Pot

Among the recent improvements in labor-saving devices is an electric solder pot with an automatic heat control manufactured by the J. D. Wallace & Co., Chicago. It is adapted to those materials which are slow conductors of heat, such as babbitt, white metal, wax, and similar substances. Because solder must not be allowed to overheat, if oxidation is to be prevented, the automatic control is set into operation, when the desired temperature is reached.

This control functions in a manner similar to that of a steam gage. A volatile substance, sensitive to heat, operates on a Bourden tube, making and breaking the flow of current and controlling the temperature of the pot. A temperature of 600 degrees Fahr. can be reached in 20 or 25 minutes and when this heat is attained the gage prevents a further rise or fall. The heating is done by a 900 watt heating element built around the container and distributing the heat to all sides of the container simultaneously.

The capacity of the pot is 15 pounds, although the weight of the heater itself is only 13 pounds. It can be carried easily and thus facilitates production by eliminating the distance from the work to a heater. It operates on either alternating or direct current and is made for 110 or 220 volts.

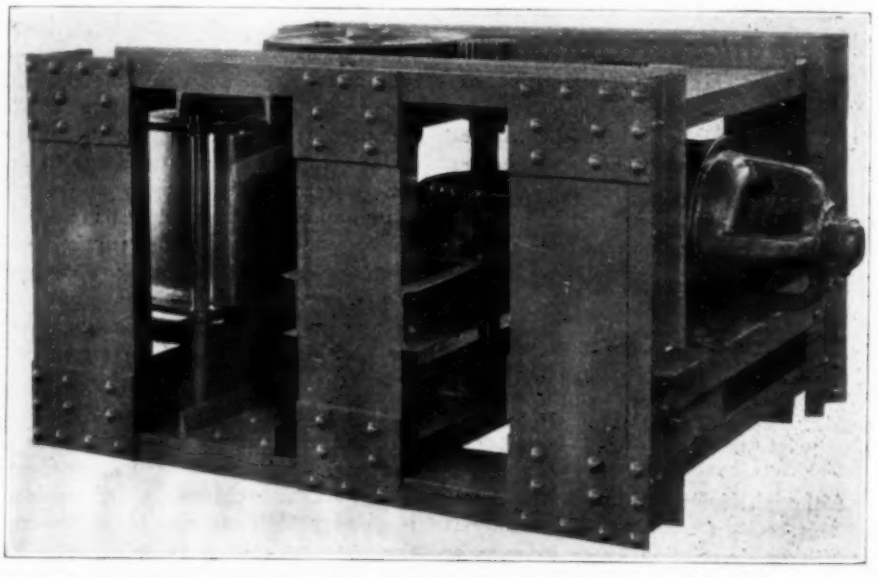
Develops Novel Portable Pneumatic Grinder

What is claimed by the manufacturers to represent something new in the way of pneumatic grinders recently has been placed on the market by the Rotor Pneumatic Co., 302 Finance building, Cleveland. In this motor the rotors are set opposite in tandem on the driving shaft thus insuring a perfect balance. Two sliding valves serve as abutments or sliding cylinder heads. After the compressed air is admitted, it is trapped back of the sliding valves and cushions them at the end of the stroke. Where the ends of the valves are held close to the rotors at all times an air tight contact is assured. This arrangement also is responsible for a noiseless, powerful motor that operates without vibration.

Develops a Heavy Duty Oven Car Puller

Designed and constructed in a special manner to meet severe operating conditions incident to moving heavily loaded cars in to and out of mold and core ovens, the car haulage shown in the accompanying illustration recently has been placed on the market by the F. A. Coleman Co., Cleveland, manufacturers of core ovens and allied equipment. The device is a self-contained unit provided with a 15-horsepower motor, operating through a drum type controller and may be bolted above the floor level to suitable foundations. The motor is connected to the drum through a worm and gear reduction train.

The 24-inch winding drum carries 120 feet of 1-inch steel cable and the cable is prevented from slipping or climbing by an idler drum which operates in close proximity to the main drum. Accuracy and ease of operation are claimed through heavy cast iron cut gears, a cut steel worm, bronze bushed bearings and an oil pipe lubricating system easily accessible from the outside. A lever projecting from one side is employed to lift one of the pinions out of mesh when it is desirable to run the drum idle. All gears and pinions are provided with safety guards. It is stated that the machine is available with the drums either in a vertical or horizontal position and therefore may be adapted to practically all conditions. One machine may be employed to move the cars in several ovens by reeving a cable through suitable snatch blocks anchored to dead men.



POWER IS TRANSMITTED FROM THE MOTOR TO THE WINDING DRUM THROUGH A STEEL WORM AND A GEAR REDUCTION TRAIN

Demand Shows Little Change

Sales in Many Classes of Foundry Equipment Are Active, While Inquiry Is of Sufficient Volume to Presage Continued Buying—Molding Machine Sales Large

INQUIRY is satisfactory in foundry equipment lines, but orders indicate little change since the first of the month. Some foundries are ordering necessary machinery for Jan. 1 delivery, evidently to hold down their inventories for the close of the year. The Toronto Foundry & Machine Co., Toronto, Ont., Canada, is in the market for bottom pour ladles. Merrill-Stevens Dry Dock & Repair Co., Jacksonville, Fla., desires to purchase cupola lining blocks. The Ruthning Works, Ltd., Wolloongabba, Brisbane, Queensland, Australia is contemplating extensive foundry extensions and will require complete molding machinery for soil pipe and fittings, bath tubs, and sanitary ware, with core room essentials for the same line of manufacture and complete sand blast installations. The Chattanooga Roofing & Foundry Co., Chattanooga, Tenn., will install brass foundry equipment, including melting units. Recent sales of sand blast equipment in the Cleveland district include the West Steel Casting Co., and the National Malleable Castings Co., Cleveland, and the Holley Carburetor Co., Detroit.

Pittsburgh Notes Improvement

OUTSTANDING in recent developments in the foundry equipment market as far as the Pittsburgh district is concerned is the sudden and yet extensive improvement in the buying rate on molding machines. The past week for instance has been the best in the history of the Herman Pneumatic Machine Co., Zelienople, Pa., and both inquiries and orders are voluminous. The salesmen report that they never have witnessed such a quick change in sentiment among buyers. Many of these pending inquiries are single installations although a comparatively large number are for pairs of machines, one for the cope and one for the drag. Others are groups of machines such as those wanted by three or four car wheel manufacturers and foundry operators in other lines of activity. Recent purchasers include the National Foundry Co., Erie, Pa., the Locomotive Stoker Co., Northside, Pittsburgh, the American Abrasive Metals Co., Irvington, N. J., the Massillon Steel Casting Co., Massillon, O., the Richmond Radiator Co., Uniontown, Pa., and the J. E. Thropp's Sons Co., Trenton, N. J., each buying large rollover machines. The Philbrick-Booth Foundry Co., Hartford, Conn., purchased two; and two of the largest units produced by the Herman company, namely its 10-ton rollover machines, were purchased by the Glen Alden Coal Co., Scranton, Pa., for flange pipe production, and the E. W. Bliss Co., Brooklyn, N. Y., for work on its large presses. However, generally speaking, the foundry equipment market is quiet, only an occasional inquiry for a cupola or blower, and an even more rare order for such equipment, being received. One local representative of a large manufacturer of foundry equipment in the east reports the recent sale of a few items such as blowers, sand machinery, etc. For the most part, inquiries are slow in turning into orders and even smaller equipment finds a light sale at the present time, more or less indifference being encountered among the buyers of riddles, flasks, wheelbarrows etc. Only one or two inquiries are before the trade for 50 to 100 flasks each. Hoist and crane purchases by foundry interests are scarce. The Keystone Driller Co., Beaver Falls, Pa., is a possible purchaser of additional foundry equipment for a one-story addition it is erecting at its foundry. The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued its fourth quarter list of equipment for foundries and machine shops, totaling 60 or 70 items.

The Metric Metal Works, Erie, Pa., has purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md. The Hatboro Foundry Co., Hatboro, Pa., has purchased a tumbling mill from the W. W. Sly Mfg. Co., Cleveland.

Few High Lights in Chicago Market

MANUFACTURERS of foundry equipment in the Chicago district report business fair—not lighter than in the first half of October, but at the same time evidencing no marked improvement. The Hanna Engineering Works, Chicago, has placed several jolt split pattern machines in the Altoona, Pa., shops of the Pennsylvania railroad and an air jolt machine in the plant of the Nordberg Mfg. Co., Milwaukee. The Beardsley-Piper Co., Chicago, has sold 10 stationary sandslingers to the Wilson Foundry & Machine Co., Pontiac, Mich.; one each of the portable type to the Riverside Iron Works, South Chicago, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and Southern Manganese Steel Co., St. Louis; one stationary to the American Castings Co., Birmingham, Ala.; one of the tractor type to the American Cast Iron Pipe Co., Birmingham, and two of the tractor type to the Central Foundry Co., New York. The National Engineering Co., Chicago, has sold sand mixers to the Treadwell Engineering Co., Easton, Pa.; Hoskins Mfg. Co., Detroit, and the Croix (France) works of the International Harvester Co. Sales of the Whiting Corp., Harvey, Ill., include a cupola to the Inman Mfg. Co., Amsterdam, N. Y.; a 25-ton ladle to the Crane Co., Chicago; and a 5-ton ladle to the National Tube Co., McKeesport, Pa. The Milwaukee Steel Foundry, Milwaukee, has ordered dust arrester equipment from the W. W. Sly Mfg. Co., Cleveland. Recent purchasers of dust arester equipment from the Pangborn Corp., Hagerstown, Md., include the Frank Foundries Corp., Moline, Ill.

Inquiry Brightens in the East

WHILE orders still are coming through slowly, inquiry is somewhat improved in the eastern foundry equipment market. Many inquiries call for single items; nevertheless, several substantial lists are either pending or likely to develop shortly. The Raritan Foundry Co., Raritan, N. J., is doubling its capacity, and will require a number of new items of equipment. Just recently this interest closed on a 10-ton electric crane, with 48-foot, 6-inch span, to the Chesapeake Iron Works, Baltimore. The Atwood Machine Co., Stonington, Conn., is also figuring on equipment for a foundry addition. The James Spence Co., Jersey City, operating a gray iron foundry, recently suffered $25,000 damage by fire. However, it will not be necessary to buy much new equipment, and the company expects to be back in full operation shortly. The 10-ton

Box overhead electric crane installed, has been sent to Philadelphia for overhauling. Fire recently damaged the plant of the Troy Foundry & Machine Co., Watervliet, N. Y., but in this case also, little new equipment will likely be required. It is understood most damage was in the pattern shop, and that the company has not found it necessary to retard operations materially. Sash Weight, Inc., Garwood, N. J., recently has established a new plant in which is installed a cupola made by the J. W. Paxson Co., Philadelphia. A large buyer of late has been the American Car & Foundry Co. This interest has closed on a number of items for its plant in Detroit, including four 36 x 72-inch tumbling barrels, which went to the Whiting Corp. The Wheeler Condenser Co., Carteret, N. J., has recently closed on two cupolas to the Whiting Corp., one to have a capacity of 12 to 14 tons per hour, and the other 18 to 21 tons per hour. The American Brakeshoe & Foundry Co., has closed on a cupola, 10 to 12 tons capacity per hour for its Kansas City plant, the orders going to the Whiting Corp. This equipment manufacturer has also just received an order for ten 4-foot turntables for the Western Electric Co., Chicago. Prospective buyers include the Olney Foundry Co., Philadelphia, which recently has awarded a contract to the Northern Construction Co., that city, for the erection of a $60,000 addition and L. Shutte, Lancaster, Pa., who is contemplating the erection of a $25,000 addition. Pierce, Butler & Pierce Mfg. Corp., Syracuse, N. Y., has purchased sand blast equipment and the American Radiator Co., Buffalo, a dust arrester installation from the Pangborn Corp., Hagerstown, Md. The W. W. Sly Mfg. Co., Cleveland, is installing sand blast equipment at the General Electric Co., Schenectady, N. Y., and has an order for three tumbling mills from Frazer & Jones Co., Syracuse, N. Y.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Automatic Tool Co., 31 Clinton street, Camden, N. J., was incorporated for $100,000 to manufacture tools.

Rebuilding of its plant, badly damaged by fire, has been begun by the Lanam Foundry Co., New Martinsville, W. Va.

Contract has been awarded by the Atwood Machine Co., Stonington, Conn., for a 2-story addition to be used as a foundry.

Pero Foundry Co., 23 Hermon street, Worcester, Mass., operator of a gray iron foundry, recently resumed operations.

The Kansas City Gray Iron Foundry, Kansas City, Mo., was incorporated recently with a capital stock of $10,000.

Sterling Brass Products Co., 18 Lyon street, Worcester, Mass., recently was organized to manufacture plumbing fixtures.

Coosa Pipe & Foundry Co., Gadsden, Ala., has acquired a site in North Carolina where it plans to build an enlargement of its plant.

The Saboco Pump Co., Baltimore, has been incorporated for $250,000 to establish a plant for the manufacture of pumps and kindred products. Charles R. Samma is incorporator.

The Downie Co., Portsmouth, Va., has been incorporated for $200,000 to establish a plant and manufacture motorized cultivator plow machines. C. E. Downie is president.

E. Daumbach, 1812 South Kilbourn avenue, Chicago, is taking bids for a $25,000 2-story, 30 x 75-foot brick foundry. C. Lenske, 3755 Irving place, Park boulevard, is architect.

Negotiations are reported to be under way by Charles H. Steadman, manager of the Faydick Furnace Co., Marietta, O., for the operation of a plant for casting stove parts.

S. R. Smythe Co., Inc., Pittsburgh, plans a brick and steel, 1-story, 100 x 288-foot, $70,000 gray iron foundry. John N. Early, 812 Sarah street, is president.

A $20,000 steel building will be erected by the Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., to replace the wooden structure built 15 years or so ago.

A 1-story 42x75-foot, $3,500 foundry addition will be built by the Blackhawk Foundry & Machine Co., 324 Clark street, Davenport, Iowa, operator of a gray iron and aluminum foundry.

A 4-story, 100 x 150-foot, concrete and brick building at Reed and South Water streets, is to be built by the International Harvester Co., 784 Park avenue, Milwaukee, operator of gray iron, brass and aluminum foundries.

Hillsen & Sandstrom, 80 Ellsworth street, Worcester, Mass., was organized recently to manufacture high grade brass, bronze, copper and aluminum castings.

Climax Engineering Co., Clinton, Ia., recently completed a new foundry and work is progressing on an office and assembling building.

Standard Foundry Co., Southgate and Armory street, Worcester, Mass., has sold its land on Stafford street to the Stone & Berg Lumber Co.

The core room of the Griffin Wheel Co., 40 Gerrish avenue, Chelsea, Mass., was damaged by fire recently with a loss approximating $25,000.

Magic Faucet Co., 454 West Chicago avenue, Chicago, has been incorporated for $5000 to manufacture and deal in plumbers' supplies, by S. S. Zito, Giovanni Veglica, Domenico Lalumia and A. R. Eld.

Spence Iron Foundry, 911 Garfield avenue, Jersey City, N. J., operator of a gray iron foundry, was damaged by fire with loss of about $100,000. Valuable dies and casts were reported lost.

The American Skein & Foundry Co., Racine Junction, Racine, Wis., operator of a gray iron and aluminum foundry, is building a 2-story brick and concrete shop addition, 40 x 140 feet.

Contract has been awarded by the Olney Foundry Co., 180 West Duncannon street, Philadelphia, subsidiary of the Link-Belt Co., Chicago, and operator of a gray iron foundry, for the erection of a $57,000 addition.

Grove Plumbing & Heating Co., 1606 East Seventy-first street, Chicago, was incorporated for $5000 by J. H. Blackwell, O. G. Jenner and Emma Blackwell McFadden, to manufacture and deal in plumbing and heating fixtures.

A. Belanger, Ltd., Montmagny, Que., operator of a gray iron, brass and aluminum foundry, is in the market for machinery and tools for manufacture of stoves, furnaces, etc. C. Belanger is purchasing agent.

American Metal Products Co., 671 Kinnickinnic avenue, Milwaukee, operator of a brass and aluminum foundry, is in the market for machinery for its new addition to its foundry and machine shop at Burnham street and Thirty-third avenue.

Nash Motors Co., Kenosha, Wis., operator of a gray iron, brass and aluminum foundry, has started work on a 1-story 190x600-foot steel and brick addition to be equipped with loadings docks, hoists, etc.

The Thompson Foundry & Machine Co., Brockton, Mass., has been incorporated for $100,000 by Elliott D. Thompson, Abington, Mass. James A. Munroe and Leverett N. Freeman, both of Newton, Mass.

To manufacture and deal in air, steam, gas and oil furnaces, stoves and heating apparatus, the Pneu Oil Burners Ltd., Toronto, Ont., was incorporated for $40,000 by John R. Rumball, Lawrence A. Landriau and Enoch G. P. Dean.

An enameling shop, 67x120 feet, is being planned by the Kohler Co., Kohler, Sheboygan county, Wis., operator of a gray iron foundry. Foundations are being laid for a packing room, 60x140 feet. Both additions will cost approximately $100,000.

Triumph Stove & Heater Co., Forty-ninth and State street, Milwaukee, manufacturer of a soft coal burner heater, and operator of a gray iron foundry, is reported as planning to locate its permanent plant in Appleton, Wis. It is manufacturing at present in temporary quarters.

A 1-story, 120x360-foot addition is being planned by the Koehring Co., Thirty-first street and Fond du Lac avenue, Milwaukee, manufacturer of gas and steam powered paving machinery concrete mixers, hoists, etc., and operator of a gray iron foundry. William J. Koehring is president and general manager.

Link-Belt Co., Thirty-ninth and Stewart avenue, Chicago, operator of gray iron and steel foundries, has purchased the Meese & Gottfried Co., San Francisco, Seattle, Los Angeles and Portland, and has formed the Link-Belt Meese & Gottfried Co. with quarters in San Francisco.

On the evening of Oct. 8, the light work foundry building of the Troy Foundry & Machine Co., Watervliet, N. Y., was badly damaged by fire. The fire was presumably caused by sparks from the cupola lodging in the dry roof, as no rain had fallen in the district for over a month. The damage, amounting to $50,000,000, is fully covered by insurance.